REPORT DOCUMENTATION PAGE 3. REPORT TYPE AND DATES COVERED 2. REPORT DATE 1. AGENCY USE ONLY (Leave Blank) Final Site Investigation Report (SI) / Jan 95 Jan 95 4. TITLE AND SUBTITLE Air National Guard Installation Restoration Program Vol Final Site Investigation Report 181st Fighter Group, Indiana ANG, Hulman MAP, Terre Haute, IN 6. AUTHOR(S) Hazardous Waste Remedial Actions Program Martin Marietta Energy Systems, Inc Oak Ridge, Tennessee 37831-7606 8. REPORTING ORGANIZATION 7. PERFORMING ORGANIZATION NAMES(S) AND ADDRESS(ES) REPORT NUMBER Task Order Authorization Y-01 Metcalf & Eddy, Inc Contract # 43B-99791C 30 Harvard Mill Square DOE Contract DE-AC05-84OR21400 Wakefield, MA 01880 10. SPONSORING / MONITORING 9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) AGENCY REPORT NUMBER ANGRC/CEVR 3500 Fetchet Avenue Andrews AFB, MD 20331 11. SUPPLEMENTARY NOTES 12b. DISTRIBUTION CODE 12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution is unlimited 13. ABSTRACT (Maximum 200 words) A Site Investigation (SI) was conducted as part of the Installation Restoration Program (IRP) for the 181st Fighter Group of the Indiana Air National Guard, Hulman Field Municipal Airport (MAP), Terre Haute, IN. Six Sites were investigated to obtain data to confirm the presence or absence of environmental contamination, to perform limited quantification of contamination if found, and to assess resulting human health and environmental risks. At five sites, although various contaminants (volatile organic compounds, polyaromatic hydrocarbon compounds, metals, and petroleum hydrocarbons) were detected, none were in sufficient concentration to cause adverse non-carcinogenic health effects and the cancer risk estimate is below the U.S. EPA target range. Hence no further action is recommended at those sites. At the sixth site nickel, chromium and lead were detected in concentrations which exceeded promulgated Federal and State standards for groundwater. Also this site is an area of high foot traffic. It is recommended that a specified grassy area be covered with concrete to help mitigate the potential for future transport of contaminants to subsurface soils and groundwater from surface runoff. 150403098 15. NUMBER OF PAGES IRP (Installation Restoration Program), CEVR, ANGRC(Air National Guard Readiness Center), SI(Site Investigation Report), 181st 314+310 = 624 Fighter Group, Hulman MAP, Terre Haute, Indiana 16. PRICE CODE 20. LIMITATION OF ABSTRACT 19. SECURITY CLASSIFICATION 18. SECURITY CLASSIFICATION 17. SECURITY CLASSIFICATION OF ABSTRACT OF THIS PAGE OF REPORT UL UNCLASSIFIED

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INSTALLATION RESTORATION PROGRAM

FINAL SITE INVESTIGATION REPORT

181ST FIGHTER GROUP INDIANA AIR NATIONAL GUARD HULMAN MUNICIPAL AIRPORT TERRE HAUTE, INDIANA

VOLUME II

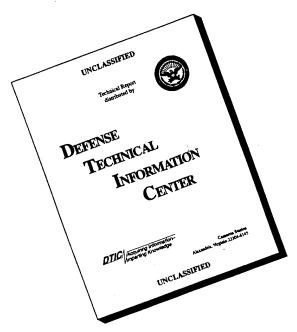
JANUARY 1995



HAZARDOUS WASTE REMEDIAL ACTIONS PROGRAM Environmental Restoration and Waste Management Programs

Oak Ridge, Tennessee 37831-7606 managed by MARTIN MARIETTA ENERGY SYSTEMS, INC. for the U.S. DEPARTMENT OF ENERGY under contract DE-AC05-840R21400

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AIR NATIONAL GUARD INSTALLATION RESTORATION PROGRAM

FINAL

SITE INVESTIGATION REPORT

VOLUME II

181st Fighter Group
INDIANA AIR NATIONAL GUARD
Hulman MAP
Terre Haute, IN
Task Order Authorization No. Y-01
Contract No. 43B-99791C

Submitted to:

AIR NATIONAL GUARD READINESS CENTER ANDREWS AIR FORCE BASE, MARYLAND

Submitted by:

HAZARDOUS WASTE REMEDIAL ACTION PROGRAM MARTIN MARIETTA ENERGY SYSTEMS, INC.

Prepared by:

METCALF & EDDY, INC. 30 Harvard Mill Square Wakefield, MA 01880

January 1995

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APPENDIX B	Piezometer/Monitoring Well Construction Diagrams
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APPENDIX F	Quality Control Data & Validation
APPENDIX G	Toxicity Profiles
APPENDIX H	1986 Analytical and Field Data From Site 4

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APPENDIX A Boring Logs

BORING LOG LEGEND

NO. Sample Identification Number

SS - Split Spoon Sampler

BC/6" - Blow Count per 6 inch advance (ASTM D 1586)

REC - % Sample Recovery in Sampling Device

(7YR6/4) Color Code from Munsell Color Chart

DATE DRILLED: 9-27-90 LOCATION: HULMAN ANG; NE of Trailer 94 DRILLING FIRM: ETI, B. Repinski GEOLOGIST: T. Francy DEPTH **SAMPLE** (Ft) NO. TYP BC/6" **REC DESCRIPTION OF STRATIGRAPHY COMMENTS** SS 3/6 - Silty loam (TOP SOIL), brown to yellow brown SS | 7/8 with rootlets, dry SS 3/5 70 -Silty CLAY (CL) to very clayey SILT, mottled HNu bkgd SS ---SS 6/8 gray and yellow brown, black mineral stains SS 1/2 and concretions, moist, becomes wet at 5' HNu bkgd SS 5 SS 3/3 SS 2/2 SS 3/4 No Sample ---- 10 SS 2/2 HNu 0.6ppm SS ---95 -As above. SS 3/3 ---- 15 SS 2/2 -Silt, to fine sand with pebbles (TILL), ---SS 25/32 medium to dense, trace organic matter, wet, HNu 0.2ppm SS --becomes dry at 20'. ---SS 15/40 60 20 SS 50(4") Total Depth=20.1 FT ---25 30 35 ---AU -in auger BZ - in breathing zone - 40 SS - split spoon sample LOG OF BORING P-1

DEPTH	H SAMPLE								
(Ft)	NO.		BC/6"	REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS			
		SS	6/10	70	-Clayey Loam (TOP SOIL), brown to yellow				
		SS	9/7		brown, stiff.				
		SS	4/4	70	-Silty CLAY (CL), brown, mottled, black				
		SS	6/6		mineral stains, stiff, plastic, moist.	HNu= 0.6ppm SS			
- 5 -		SS	2/3	90	-As above, trace fine sand				
			4/3			HNu= 0.4ppm SS			
			1/2	100					
			3/4		-Sandy CLAY (CL), brown, stiff, plastic, moist	HNu= 0.4ppm SS			
		1	2/3	100	angular, increasing sand with depth.				
- 10 -			3/5						
			1/2	60					
			3/5	<u> </u>	-SAND (SP) to 14.5'medium to fine grained, with				
			4/4	80	pebbles, trace clay, becomes more clayey with				
45			6/4	100	depth, moist.				
- 15 -		1	3/7	100	-Silty CLAY (CL), brown to 15', moist.				
		33	15/7	 	-Silt to fine sand with pebbles (TILL), gray,				
			į		hard, dry.				
- 20 -					-Total Depth = 20.2 FT				
					- Total Boptii - 20.2 i i				
- 25 -									
- 30 -									
						1			
- 35 -									
					All in ourse				
					AU – in auger				
- 40 -					BZ – in breathing zone SS – split spoon sample				
			<u> </u>			<u>.</u>			
	LOG OF BORING P-2								

LOCATION: HULMAN ANG; Next to DRILLING FIRM: ETI, B. Repinski					; Next to Jetway DATE DRILLED: epinski GEOLOGIST:	9-27-90 T. Francy	
DEPTH (Ft)			IPLE BC/6"	REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS	
					No samples collected 0-15 feet.	HNu= 0.0 ppm SS	
- 5 -							
					, -		
				İ			
- 10 -							
	,						
- 15 -						HNu= 0.0 ppm SS	
		SS	1/3	85	-CLAY (CL), brown to yellow, grades to silty	HNu= 0.0 ppm SS	
		SS			clay with some sand and organic matter,	HNu= 0.0 ppm SS	
					moist.		
- 20 -			15/20 30/34	80	- TILL, fine, some clay and silt, trace gravel, moist.		
- 20 -		33	30/34		- Total Depth = 20.2 FT.		
					1 0 tal. 2 0 pt. 1 = 2 0 12 1 1 1		
- 25 -							
- 30 -							
- 35 -							
					AU – in auger		
					BZ - in breathing zone		
- 40 -					SS - split spoon sample		
	LOG OF BORING P-3						

LOC <i>A</i> DRILI	9-26-90 T. Francy													
DEPTH (Ft)	NO.	SAMPLE O. TYP BC/6"				SAMPLE IO. TYP BC/6"						REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS
			3/4 5/5	50	-clayey, SILT, gray to yellow brown, with roots.									
		SS	2/4 4/6	75	-Silty CLAY (CL), gray to yellow brown, moist. Increasing silt with depth.	HNu= bkgd								
- 5 - 		SS	2/2 3/4	80	-As above, wet	HNu= bkgd								
		SS	1/2 2/3			HNu= bkgd								
 - 10 -														
			2/2 2/3	85		HNu= bkgd								
 - 15 -														
			2/3 20/20	80	-Clay, with sand, silt and gravel (TILL), very dense, wet.									
			1	10"	-As above, dry.									
- 20 <i>-</i> 		SS	(2")		-Total Depth = 20 FT									
	:													
- 25 -														
				:										
- 30 -														
 - 35 -														
 - 40 -					AU – in auger BZ – in breathing zone SS – split spoon sample									
	LOG OF BORING P-4													

LOCA DRILI	LOCATION: P-5 DRILLING FIRM: ETI, B. Repinski GEOLOGIST: T. Aebie								
DEPTH (Ft)			IPLE BC/6"	REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS			
			4/9	60	-Silt and clay loam (TOP SOIL), damp.				
		ss ss	13/17 6/4	80	-Silty CLAY (CL), brown, stiff, dry.	HNu= bkgd SS			
		SS	6/9						
- 5 -		SS	,	100					
		SS SS		95					
		SS							
		SS		100	-Silty CLAY (CL), gray, trace fine to medium	HNu = bkgd SS			
- 10 -		<u>ss</u> ss	3/4	90	sand, stiff, increasing sand with depth, moist.				
		SS		90					
45									
- 15 -		SS	3/6	70	-Sandy Clay (TILL) with small pebbles, wet, firm.	HNu= bkgd SS			
			9/10		Candy Clay (1122) min cinan possibly mot, min				
 - 20 -			20/50 (4″)	80	-As above, dry Total Depth = 20.1 FT.				
- 20 -		33	(4)		Total Depth = 20.1 F1.				
- 25 -									
- 30 -									
- 35 -									
		~			AU - in auger				
					BZ – in breathing zone				
- 40 -					SS - split spoon sample				
				LO	G OF BORING P-5				

DATE DRILLED: 9-28-90 LOCATION: HULMAN ANG; NW of Bldg 26 DRILLING FIRM: ETI, B. Repinski GEOLOGIST: T. Francy DEPTH **SAMPLE** NO. TYP BC/6" (Ft) REC **DESCRIPTION OF STRATIGRAPHY COMMENTS** SS 6/8 ---80 -Silt and Clay (TOP SOIL), brown to gray, SS 8/10 mottled at 1', slightly moist. HNu= bkgd SS ---SS 6/8 ---80 -Silty CLAY (CL), gray to yellow brown, mottled, SS |11/10 locally abundant concretions and black stains, HNu= bkgd SS ---5 SS 2/2 85 moist. SS 2/4 ----Clayey SILT (ML), becomes wet, soft. HNu= bkgd SS SS 2/2 100 SS 4/5 ---SS 2/2 100 10 SS 4/4 HNu= 0.1ppm SS ---SS 1/1 90 -becomes very clayey, gray to yellow brown, SS 2/2 --with iron concretions, wet. ---15 ___ SS 4/24 60 -Silt and clay (TILL), gray with sand and trace SS |50(4") gravel, dense, 45 degree fracture, --dry at 16.5'. SS 27/50 20 SS (5") -Total Depth = 19.8 FT.---___ 25 ---30 ---35 AU - in auger BZ - in breathing zone 40 SS - split spoon sample LOG OF BORING P-6

LOC <i>A</i> DRILI	LOCATION: HULMAN ANG, 2' NW of Site DATE DRILLED: 9-29-90 DRILLING FIRM: ETI, B. Repinski GEOLOGIST: T. Aebie								
DEPTH (Ft)	NO.		APLE BC/6"	REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS			
		1	9/33 9/3	0	-No recovery, rock in spoon.	HNu= 0.0 ppm SS HNu= 0.0 ppm SS			
		SS	3/3 5/7	90	-Silty CLAY (CL) black, mottled brown, moist	HNu= 0.0 ppm SS			
- 5 -		SS	4/4 4/5	100	-As above, trace fine sand.	HNu= 0.0 ppm SS			
	1	SS	1/1 3/4	100	-Silty CLAY (CL), brown with black mineral stains, weathered horizon at 7.5', small rocks				
	**	SS	1/1	80	present, some sand, moist.	HNu= 0.1 ppm SS			
- 10 - 		SS	1/2 1/1 1/3	70	-Sandy CLAY (CL), grey, abrupt contact, wet at 11.5'.				
		33	1/3		wetat 11.5.				
- 15 -			ļ			HNu= 0.1 ppm SS			
			12/20	80	-TILL, interbedded sand and sandy clays,	7 114u = 0.1 ppiii 00			
		55	32/27	ļ	discontinuous, trace pebbles, wet.	HNu= 0.4 ppm SS			
		SS	26/50	100	-As above, no pebbles.	III			
- 20 -			(4")		- Clayey Sand, grey, firm to stiff				
					at 18.5'.				
					-Total Depth = 20.05 FT.				
- 25 -									
- 30 -									
- 35 -									
	ļ				AU - in auger				
- 40 -					BZ – in breathing zone SS – split spoon sample				
	LOG OF BORING P-7								

LOC <i>A</i> DRILI	9-28-90 T. Aebie							
DEPTH	SAMPLE		SAMPLE		SAMPLE			
(Ft)			BC/6"	REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS		
		1	4/7	70	-TOP SOIL, light brown, trace pebbles,	HNu= 0.0 ppm SS		
			9/1		dry.	HNu= 0.0 ppm SS		
		4	2/4 6/8	70	-Silty CLAY (CL), brown, black mottling, some mineral stains, moist.			
- 5 -			1/2	75	-As above, becomes grey, at 5.5', mottled,	HNu= 0.0 ppm SS		
		SS	2/3		moist, trace sand and silt from 6-8'.	HNu= 0.0 ppm SS		
			2/2	95				
			4/5					
			1/2	80	-Clayey SAND (SC), medium grained, grey with			
- 10 -			2/3		brown mottling, some silt, moist, water	HNu= 0.0 ppm SS		
		1	1/2 2/3	75	encountered at 11'.			
- 15 -						HNu= 0.0 ppm SS		
			2/2	70	-TILL, Silty Sand (SM), grey, trace cobbles,			
		SS	3/1					
		00	12/13	- 00		1111 0.0 00		
 - 20 -		l	12/13	80	-Total Depth = 20.3 Ft.	HNu= 0.0 ppm SS		
			1.20		10ta 50pa = 20.01 t.			
- 25 -								
- 30 -								
- 35 -								
					AU – in auger			
					BZ – in breathing zone			
- 40 -					SS - split spoon sampling			
	LOG OF BORING P-8							

	LOCATION: HULMAN ANG, Background Area. DRILLING FIRM: ETI, B. Repinski DATE DRILLED: 10-11-90 GEOLOGIST: T. Aebie								
DEPTH (Ft)			IPLE BC/6"	REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS			
		ı	10/20 20/21	100	-Silty CLAY (CL), brown (7.5YR5/4), moist.	HNu= 0.0 ppm SS HNu= 0.0 ppm SS			
		SS SS	7/9 9/7		CALIFORNIA SPLIT SPOON, SAMPLES NOT LITHOLOGICALLY LOGGED.				
- 5 -			6/6 6/8			HNu= 0.0 ppm SS			
		SS SS	1/1	90	-Sandy SILT (ML), brown (7YR6/4), mottled, wet.				
 - 10 -						HNu= 0.0 ppm SS			
		SS SS	1/1	90	-Fine SAND (SP), light brown (7YR6/4), mottled, some clay, plastic, wet.				
					,				
- 15 -		SS	10/25		-TILL encountered at 15.5', grey, trace				
			41/50		pebbles, dry.				
- 20 -			12/13 12/9	80					
			12.0		Total Depth = 20 feet.				
- 25 -									
- 30 - 									
- 35 -									
					All in cuper				
 - 40 -					AU – in auger BZ – in breathing zone SS– split spoon sample				
	<u> </u>			LO	G OF BORING BHB-01				

LOCA DRILI	LOCATION: HULMAN ANG, BH5-02 DATE DRILLED: DRILLING FIRM: ETI, B. Repinski GEOLOGIST:								
DEPTH (Ft)	NO.		BC/6"	REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS			
		SS	10/20 22/25		CALIFORNIA SPLIT SPOON, SAMPLES NOT LOGGED. 1-7 feet.	HNu=3.0 ppm AU HNu=0.0 ppm BZ			
		SS	6/7 9/12			OVA=1 ppm SS OVA=5 ppm SS			
- 5 - 		SS SS				OVA=3 ppm SS			
 - 10 -						HNu=3.2 ppm AU			
		SS SS			-SAND (SP), brown to gray, mottled and wet	HNu=0.0 ppm BZ OVA= <0.1 ppm SS			
- 15 -						HNu= 0.0 ppm SS			
		SS SS		80	-SAND (SP), fine to medium grained, clay. Dry TILL at 16.5 feet, hard,	OVA= <0.1 ppm SS			
					pebbles				
 - 20 -					Total depth = 17 feet.				
- 25 -									
 - 30 -									
- 35 -									
					AU – in augers				
 - 40 -					BZ – in breathing zone SS – split spoon sample				
			<u> </u>	LO	G OF BORING BH5-02				

DEPTH SAMPLE PRODUCT BC/6* REC DESCRIPTION OF STRATIGRAPHY COMMENTS				ULMAN M: ETI,		, BH5-03 DATE DRILLED: GEOLOGIST:	10–12–90 T. Aebie
SS 9/15 SS 17/25 SS 17/25 SS 17/8 SS 9/11 SS 8/8 SS 8/8 SS 8/8 SS 2/2 SS 3/11 SS 1/2 SS 1/2 SS 3/4 SS 3/4 SS 3/4 SS 3/5 SS 1/2 SS 3/6 SS 3/6 SS 3/6 SS 1/2 SS 3/6 SS 3/6 SS 3/6 SS 3/6 SS 3/6 SS 3/7 SS 3	DEPTH		_				
SS 9/15 NOT LOGGED (1-7 ft) SS 17/25 SS 7/8 SS 9/11 SS 4/6 SS 8/8 SS 8/8 SS 8/8 SS 8/8 SS 1/2 SS 3/11 SS 1/2 SS 1/2 SS 2/4 STOWN (SP), fine to medium grained, trace clay, brown gray, moist. SS 1/2 SS 1/2 SS 2/4 STOWN (SP), medium grained, light brown (SYRS/6), massive, wet. SS 3/10 SS 30/50 SS 2/4 STOWN (SYRS/6), massive, wet. SS 30/50 SS	(Ft)	NO.	TYP	BC/6"	REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS
			SS				
- 5 - SS 9/11 SS 4/6 SS 5/2 SS 3/11 SS SS 5/2 SS 5/2 SS 5/2 SS 5/2 SS 5/4 ST 5/4 ST 5/4 SS 5/4 ST 5/4							HNu= 0.0 ppm SS
	- 5 -						OVA< 0.1 ppm SS
SS 8/8			1				HNu= 5.0 ppm AU
							HNu= 0.0 ppm BZ
- 10 -							OVA= 6.0 ppm SS
SS 2/2 100							
SS 3/11 trace clay, brown gray, moist. SS 1/2	- 10 -						
SS 1/2 SS 2/4 brown (5YR5/6), massive, wet. SS 30/50 Total depth = 20 feet.			ı		100	1	OVA< 0.1 ppm SS
SS 1/2 SS 2/4 SAND (SP), medium grained, light brown (5YR5/6), massive, wet SS 30/50 (6°) SS 30/50 (6°) SAND (SP), medium grained, light brown (5YR5/6), massive, wet SS 30/50 (6°) SS 30/50 (6°)			SS	3/11		trace clay, brown gray, moist.	
SS 1/2							
SS 1/2	15				 		HNu= 0.0 ppm SS
SS 2/4 brown (5YR5/6), massive, wet. SS 30/50 (6") TILL, massive, dense, subangular pebbles, dry. Total depth = 20 feet. Total depth = 20 feet. AU - in augers BZ - in breathing zone SS - split spoon sample	- 15 -		00	1/2		SAND (SP), medium grained, light	• •
SS 30/50 (6") TILL, massive, dense, subangular pebbles, dry. Total depth = 20 feet. Total depth = 30 feet.			ı	i			Pp.
			33	214		brown (6 11 to/0), massive, wet.	
- 20 - (6")			SS	30/50	1	TILL, massive, dense, subangular pebbles, dry.	
Total depth = 20 feet. Total depth = 20 feet. Total depth = 20 feet. AU - in augers BZ - in breathing zone SS - split spoon sample				l			
-2530353535				<u> </u>			
-2530353535							
						Total depth = 20 feet.	
AU – in augers BZ – in breathing zone SS – split spoon sample	- 25 -						
AU – in augers BZ – in breathing zone SS – split spoon sample							
AU – in augers BZ – in breathing zone SS – split spoon sample							
AU – in augers BZ – in breathing zone SS – split spoon sample							
AU – in augers BZ – in breathing zone SS – split spoon sample	- 30 -						
AU – in augers BZ – in breathing zone SS – split spoon sample	·			1			
AU – in augers BZ – in breathing zone SS – split spoon sample							
AU – in augers BZ – in breathing zone SS – split spoon sample]						
AU – in augers BZ – in breathing zone SS – split spoon sample							
BZ – in breathing zone SS – split spoon sample	- 35 -						
BZ – in breathing zone SS – split spoon sample							
BZ – in breathing zone SS – split spoon sample						All in compare	
- 40 - SS - split spoon sample						=	
	- 40 -					SS – split spoon sample	
	70 -		<u> </u>	ļ			

DEPTH (FI) NO. TYP 8C6" REC DESCRIPTION OF STRATIGRAPHY COMMENTS				ULMAN M: ETI,		, BH6-04 DATE DRILLED: GEOLOGIST:	
Fig. NO. TVP BC/6" REC DESCRIPTION OF STRATIGRAPHY COMMENTS	DEPTH		SAM	IPLE			
SS 20/20 NOT LOGGED. 0-6 feet. HNu= 7.0 ppm AU HNu= 0.0 ppm BZ OVA= 7 ppm SS HNu= 7.0 ppm AU HNu= 0.0 ppm BZ OVA= 8 ppm SS HNu= 7.0 ppm AU HNu= 0.0 ppm BZ OVA= 8 ppm SS HNu= 7.0 ppm AU HNu= 0.0 ppm BZ OVA= 8 ppm SS OVA= 2 ppm SS OVA= 0.3 pp SS OV		NO.			REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS
			SS	15/20		CALIFORNIA SPLIT SPOON, SAMPLES	OVA= 2.5 ppm SS
SS 8/15 SS 16/14 SS 16/14 SS 8/10 SS 8/10 SS 1/2 SS 1/2 SS 1/2 SS 2/4 SS 2/4 SS 7/12 SS 2/3 SS 7/12 SS 7/1						1	HNu= 7.0 ppm AU
- 5 - SS 5/7			SS	8/15			HNu= 0.0 ppm BZ
SS 8/10 SS 1/2 SS 2/4 SS 2/4 SS 2/4 SS 2/4 SS 7/12			SS	16/14			OVA= 7 ppm SS
	- 5 -		SS	5/7			1 ''
			SS	8/10			1 ''
- 10 -							OVA= 8 ppm SS
- 10 -					<u> </u>		
SS 1/2							
SS 2/4 pebbles, wet. SS 2/3 SS 2/3 As above TILL at 16.7 feet.	- 10 -						1 '''
SS 2/31 SS 7/121 SS			1	1		1	OVA= .2 ppm SS
SS 2/3			SS	2/4		pebbles, wet.	
SS 2/3							
SS 2/3					<u> </u>		
SS 7/12 -TILL at 16.7 feet. OVA= 0.3 pp SS 20 -	- 15 -				ļ		LINI. O O nom CC
			1	1			1
			SS	7/12	ļ	- ILL at 16.7 feet.	OVA= 0.3 pp 33
						Total Donth - 17 foot	
	- 20 -					Total Depth = 17 feet.	
	l						
	- 25 -						
AU – in auger BZ – in breathing zone SS – split spoon sample							
AU – in auger BZ – in breathing zone SS – split spoon sample							
AU – in auger BZ – in breathing zone SS – split spoon sample			Ì				
AU – in auger BZ – in breathing zone SS – split spoon sample							
AU – in auger BZ – in breathing zone SS – split spoon sample	- 30 -						
AU – in auger BZ – in breathing zone SS – split spoon sample							
AU – in auger BZ – in breathing zone SS – split spoon sample							
AU – in auger BZ – in breathing zone SS – split spoon sample							
AU – in auger BZ – in breathing zone SS – split spoon sample	!						
BZ – in breathing zone SS – split spoon sample	- 35 -						
BZ – in breathing zone SS – split spoon sample		1					
BZ – in breathing zone SS – split spoon sample					1	l	
- 40 - SS - split spoon sample						<u> </u>	
]					
LOG OF BORING BH6-04	- 40 -			Ì			

LOCA DRILI	LOCATION: HULMAN ANG, BH6-05 DRILLING FIRM: ETI, B. Repinski DATE DRILLED: GEOLOGIST:									
DEPTH (Ft)			MPLE BC/6" REC		DESCRIPTION OF STRATIGRAPHY	COMMENTS				
			8/10 12/15		CALIFORNIA SPLIT SPOON, SAMPLES NOT LOGGED. 0-6 feet.	OVA= 80 ppm SS				
		SS	8/10		NOT LOGGLD. 0-0 leet.	OVA= 40 ppm SS				
- 5 -		SS	1			OVA= 6 ppm SS				
		SS	6/8							
- 10 - 		SS	1/2		SAND (SP) fine to medium, and CLAY (CL),	OVA= 0.2 ppm SS				
		SS	3/3		mottled brown and gray, no pebbles, wet.					
 - 15 -						OVA= 0.2 ppm SS				
		SS SS	25/31		-Dry TiLL at 15 feet, brown, becomes gray, sand, pebbles and clay.					
		00			dana, possios and diaj.					
- 20 -					Total Depth = 17 feet.					
 - 25 -										
- 25 -										
- 30 -										
- 35 - 										
					AU – in auger					
 - 40 -					BZ – in breathing zone SS – split spoon sample					
				LOG	OF BORING BH6-05					

LOCATION: HULMAN ANG, BH2-06 DRILLING FIRM: ETI, B. Repinski DATE DRILLED: 10-13-9 GEOLOGIST: T. Aebie									
DEPTH (Ft)	NO.		PLE BC/6"	REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS			
	1.2	SS	5/11 13/20		CALIFORNIA SPLIT SPOON, SAMPLES NOT LOGGED. 0-6 feet.	OVA= 0.4 ppm SS			
 5 -	· · · ·	l	5/4 6/6			HNu= 0.1ppm SS OVA= 2.5 ppm SS HNu= 0.0ppm SS			
		SS				OVA= 9.0 ppm SS			
						HNu= 0.0ppm SS			
- 10 - 		l	2/3 4/5		-SAND (SP), fine to medium grained, gray, some clay, moist, few pebbles.	OVA= 1.0 ppm SS			
						OVA= 0.6 ppm SS			
- 15 - 		1	2/4 5/7		As aboveTILL, at 17.5 feet, massive sand, gray,	OVA= 0.0 ppm 33			
					little clay, wet. Total Depth = 17.5 feet.				
- 20 - 									
- 25 - 									
- 30 - 									
- 35 - 					·				
 - 40 -					AU – in augers BZ – in breathin zone SS – split spoon sample				
		L	ļ	LO	G OF BORING BH2-06				

LOCA DRILL	LOCATION: HULMAN ANG, BH2-07 DRILLING FIRM: ETI, B. Repinski DATE DRILLED: 10-13-90 GEOLOGIST: T. Aebie									
DEPTH (Ft)			PLE BC/6"	REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS				
 - 5 -		SS SS SS	3/10 11/14 11/13 13/16 2/3 7/8		CALIFORNIA SPLIT SPOON, SAMPLES NOT LOGGED. 0-6 feet.	HNU= 0.0 ppm SS OVA= 4.2 ppm SS HNU= 10.0 ppm AU HNU= 0.0 ppm BZ OVA= 12 ppm SS OVA= 4.0 ppm SS				
 - 10 -			1/2	100	–SAND (SP), medium grained, gray, mottled brown, wet.	HNU= 1.5 ppm AU HNU= 0.0 ppm BZ OVA= 3.8 ppm SS				
 - 15 - 		SS SS	1/1		-SAND (SM), coarse grained, unconsolidated, wet. TILL, @ 17 ft.	HNU= 0.5 ppm SS OVA= 3.8 ppm SS				
 - 20 - 					Total Depth = 17 feet.					
- 25 - 										
- 30 - - 35 -										
 - 40 -					AU – in auger BZ – in breathing zone SS – split spoon sample					
				LO	G OF BORING BH2-07					

LOCA DRILI	LOCATION: HULMAN ANG, BH2-08 DRILLING FIRM: ETI, B. Repinski DATE DRILLED: 10-13-90 GEOLOGIST: T. Aebie									
DEPTH		SAM	IPLE			_				
(Ft)	NO.	TYP	BC/6"	REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS				
		SS	3/11		CALIFORNIA SPLIT SPOON, SAMPLES	HNu= 0.0 ppm SS				
			15/17		NOT LOGGED. 0-6 feet.	OVA= 3.5 ppm SS				
		SS	6/9							
		SS	15/17			OVA= 3.0 ppm SS				
- 5 -		SS	3/6			HNu= 0.0 ppm SS				
		SS	9/9	<u></u>		OVA= 1.6 ppm SS				
						0.0 00				
- 10 -						HNu= 0.0 ppm SS				
			1/2	100	-SAND (SP), medium to fine grained	OVA= 0.6 ppm SS				
		SS	3/5	ļ	brown gray, mottled, plastic, moist.					
45	-		<u> </u>	ļ		HNu= 0.1 ppm SS				
- 15 -		99	6/10	ļ	 -SAND (SP), medium grained, brown	OVA= 0.2 ppm SS				
		1	11/11		grey mottled, wet. Dry TILL at 16.4	от от рригоз				
		00	1 17 1 1	\vdash	ft., grey, hard					
					Total Depth = 17 feet.					
- 20 -										
- 25 -										
- 30 -										
- 35 -										
					AU in auger					
					BZ - in breathing zone					
- 40 -	-				SS - split spoon sample					
				LO	G OF BORING BH2-08					

LOCA DRILI	LOCATION: HULMAN ANG, BH2-09 DRILLING FIRM: ETI, B. Repinski DATE DRILLED: 10-13-90 GEOLOGIST: T. Aebie										
DEPTH (Ft)	NO.		IPLE BC/6"	REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS					
 - 5 - 		SS SS SS	16/18 25/18 8/13 15/21 2/5 10/11		CALIFORNIA SPLIT SPOON, SAMPLES NOT LOGGED. 0-6 feet.	OVA = 1.2 ppm SS HNu = 3.0 ppm AU HNu = 0.0 ppm BZ OVA= 12 ppm SS HNu = 0.0 ppm SS OVA= 2.0 ppm SS					
 - 10 - 		SS SS		100	-Clayey SILT (ML), gray, stiff, plastic, trace medium grained dark gray sand, moist.	HNu = 1.0 ppm AU OVA= 0.3 ppm SS					
- 15 - 			9/10 10/12		-SAND (SP), coarse grained, gray, some pebbles, wet. Dry TILL, at 17 ft., hard. Total Depth = 17 feet.	HNu = 3.0 ppm AU HNu = 0.0 ppm BZ OVA= 0.6 ppm SS					
- 20 - 			·								
- 25 - - 30 -											
 - 35 -											
 - 40 -				BZ - SS -	in auger in breathin zone split spoon sample						
				LO(G OF BORING BH2-09						

LOC/ DRIL	ATION LING	V: H	ULMAN M: ETI,	ANG B. Re	pi, BH4-10 DATE DRILLED: GEOLOGIST:	10–14–90 T. Aebie
DEPTH (Ft)			IPLE BC/6"	REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS
		SS	5/15 17/30		CALIFORNIA SPLIT SPOON, SAMPLES NOT LOGGED. 0–6 feet.	HNu= 0.0 ppm SS OVA= 1.0 ppm SS
		SS	7/9 11/30			OVA= 4.0 ppm SS HNu= 0.0 ppm SS
- 5 - 		1	4/8 5/10			OVA= 6.0 ppm SS
- 10 - 		SS		90	-SAND (SP), medium grained, gray brown,	OVA= 0.5 ppm SS
		SS			some clay, very moist.	
- 15 -		SS	1/3		-As above, wet.	HNu = 0.0 ppm SS
		1	5/15		-TILL, at 16.5 feet, gray, hard, dry.	OVA = 0.6 ppm SS
 - 20 -					Total Depth = 17 feet.	
 - 25 -						
 - 30 -						
- 35 - 						
- 40 -				1.04	G OF BORING BH4-10	
				<u> </u>	a OF BURING BH4-10	

LOCA DRILI	LOCATION: HULMAN ANG, BH4-11 DATE DRILLED: 10-14-90 GEOLOGIST: T. Aebie									
DEPTH (Ft)	NO.		IPLE BC/6"	REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS				
 - 5 - 		SS SS SS	4/7 15/32 7/10 13/14 3/6 6/9		CALIFORNIA SPLIT SPOON, SAMPLES NOT LOGGED. 0-6 feet.	OVA= 0.4 ppm SS HNu= 1.0 ppm AU HNu= 0.0 ppm BZ OVA= 10.0 ppm SS HNu= 0.0 ppm SS OVA= 8.0 ppm SS				
 - 10 - 		1	4/4 5/9	100	-SAND (SP), medium grained, gray brown, some clay, very moist, few pebbles.	HNu =0.0 ppm SS OVA= 0.4 ppm SS				
- 15 - 			1/3 5/15		As above, wet. -TILL, at 16.5 feet, gray, hard, massive, dry. Total Depth = 17.5 feet.	HNu =0.0 ppm SS OVA= 0.2 ppm SS				
- 20 - - 25 -										
- 25 - - 30 -										
 - 35 -										
 - 40 -					AU – in auger BZ – in breathing zone SS – split spoon sample G OF BORING BH4–11					

	LOCATION: HULMAN ANG, BH4-12 DATE DRILLED: 10-14-90 GEOLOGIST: T. Aebie									
DEPTH (Ft)			IPLE BC/6"	REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS				
 - 5 - 		SS SS SS	3/6 7/11 6/11 13/17 3/6 6/9		CALIFORNIA SPLIT SPOON, SAMPLES NOT LOGGED. 0-6 feet. Saturated	HNu= 0.0 ppm SS OVA= 0.0 ppm SS HNu= 0.0 ppm SS OVA= 2.0 ppm SS OVA= 1.8 ppm SS				
- 10 - 		1	2/2 2/4		-SAND (SP), brown, mottled, wet.	OVA= 0.2 ppm SS				
- 15 - - 20 -			2/4 6/16		-SAND (SP), medium grained, gray, few pebbles, wet. TILL, at 16 feet, light gray, hard, dense, pebbles, little sand and clay, dry.	OVA= 0.2 ppm SS				
 - 25 - - 30 - - 35 -					Total Depth = 17 feet.					
 - 40 -				LO	AU – in auger BZ – in breathing zone SS – split spoon sample G OF BORING BH4–12					

LOC/ DRIL	LOCATION: HULMAN ANG, BH4-13 DRILLING FIRM: ETI, B. Repinski DATE DRILLED: 10-14-90 GEOLOGIST: T. Aebie									
DEPTH (Ft)	NO.		PLE BC/6"	REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS				
			6/11 10/9		CALIFORNIA SPLIT SPOON, SAMPLES NOT LOGGED. 0-6 feet.	OVA= 0.6 ppm SS				
		SS	6/11 12/18			HNu= 0.0 ppm SS OVA= 6 ppm SS				
- 5 - 		•	1/4 6/8			HNu= 0.4 ppm SS OVA= 2.2 ppm SS				
					-					
- 10 - 		l	2/2		-SAND (SP), brown, medium grained,	OVA< 0.1 ppm SS				
		SS	3/3		mottled, wet.					
- 15 -										
		SS SS	4/5 6/13		-SAND (SP), gray, unconsolidated, few pebbles, wet.	HNu= 0.2 ppm SS OVA= 0.4 ppm SS				
 - 20 -					-TILL, at 16.5 feet, light gray, hard, dense, pebbles, little sand and clay, dry.					
					Total Depth = 17 feet.					
- 25 - 										
- 30 - 	=									
- 35 -										
					AU – in auger					
 - 40 -					BZ – in breathing zone SS – split spoon sample					
				LOC	OF BORING BH4-13					

LOCA DRIL	LOCATION: HULMAN ANG, BH1-14 DATE DRILLED: 10-15-90 DRILLING FIRM: ETI, B. Repinski GEOLOGIST: T. Aebie								
DEPTH (Ft)			IPLE BC/6"	REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS			
		SS	10/15 27/25 4/17		CALIFORNIA SPLIT SPOON, SAMPLES NOT LOGGED. 0–6 feet.	HNu= 0.0 ppm SS OVA= 1.5 ppm SS OVA= 2 ppm SS			
 - 5 -		SS SS	17/19 3/6 8/9			HNu= 0.1 ppm SS OVA= 2.4 ppm SS			
- 10 - 		SS SS	1/2 2/4		-SAND (SP), fine to medium grained, grey with brown mottles, some clay, wet.	HNu= 0.0 ppm SS OVA= 0.8 ppm SS			
 - 15 -		22	25/31		TUIL at 15 fact arou hard same sand do.	HNu= 0.0 ppm SS			
			50(1")		-TILL, at 15 feet, gray, hard, some sand, dry. Total Depth = 17 feet.	OVA= 0.2 ppm SS			
- 20 - 									
 - 25 -									
- 30 - 									
- 00 -					AU – in auger				
- 40 -					BZ - in breathing zone SS - split spoon sample G OF BORING BH1-14				

LOCA DRIL	LOCATION: HULMAN ANG, Site 1 north of Taxiway. DRILLING FIRM: ETI, B. Repinski GEOLOGIST: T. Aebie									
DEPTH (Ft)	NO.		MPLE BC/6"	REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS				
		SS	15/22 20/20		CALIFORNIA SPLIT SPOON, SAMPLES NOT LOGGED.	OVA= 0.4 ppm SS HNu= 0.0 ppm SS				
		SS	5/6 7/8			OVA= 1.0 ppm SS HNu= 0.0 ppm SS				
- 5 - 		•	4/5 5/6			OVA= 6.0 ppm SS				
- 10 - 		SS			SAND (SP), fine to medium grained, gray with	HNu= 0.0 ppm SS OVA= 0.2 ppm SS				
		SS			brown mottles, some clay, wet.					
 - 15 -						OVA= 0.2 ppm SS				
		SS SS			-As above -TILL at 16 feet, moist, soft, sand, clay					
 - 20 -	-				and pebbles. Total Depth = 17 feet.					
					70ta 20pti = 17 100ti					
						;				
- 25 - 			,							
- 30 -										
 - 35 -										
 - 40 -				ŀ	AU – in auger BZ – in breathing zone SS – split spoon sample					
					G OF BORING BH1-15					

LOCATION: HULMAN ANG, SW of Site 1. DATE DRILLED: 10-16-90 GEOLOGIST: T. Aebie								
DEPTH (Ft)	NO.		MPLE BC/6"	REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS		
		SS	8/8 9/10		-Silty CLAY, gray (10YR7/1) and yellow brown (10YR6/8 to 5/8), mineral stains, dry.	HNu= 0.0 ppm SS		
			3/3 4/5	75	-Clayey SILT, gray (10YR7/1) with yellow brown (10YR6/8) mottles, moist.	HNu= 0.0 ppm SS		
- 5 -		l .	1/2 3/4	80	-As above, moist to wet			
		00	0.14		- -			
- 10 - 		SS	1/1	80	Clayey SILT, gray (As Above) and yellow	HNu= 0.1 ppm SS HNu= 0.0 ppm SS		
			2/4		brown (As Above) trace fine to medium sand,	7114u= 0.0 ppm 00		
					Fe concretions.			
- 15 -								
		SS	9/17	90	-TILL, brown (5Y4/3 to 4/4) and gray			
			50(5")		(10YR6/1 to 5/1), clay with silt, sand,			
					fine to medium gravel, dense, becomes sandy at 16 feet.			
- 20 -					at 10 100th			
					Total depth = 20.1 feet.			
- 25 -								
- 30 -								
- 35 -								
- 35 -								
					AU – in auger			
					BZ – in breathing zone			
- 40 -					SS – split spoon sample			
LOG OF WELL MW1-06								

LOC <i>A</i> DRILI	LOCATION: HULMAN ANG, SW of Site 2 in Roadway DATE DRILLED: 10-17-90 GEOLOGIST: T. Aebie							
DEPTH (Ft)	NO.		IPLE BC/6"	REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS		
		SS						
			17/11	60	-Very clayey SILT (ML), grey, dry.			
		l	8/8					
			2/3	10	Silty CLAY (CL), yellow brown to grey, moist.			
- 5 -			4/5	7.5	CLAY (CL) and CHT (MI) wellow brown to	HNu = 0.4 ppm SS		
			1/2 3/3	/5	-CLAY (CL) and SILT (ML), yellow brown to grey 10YR5/6 and 2.5YR7/0, becomes dark			
		SS	3/3		grey 7.5YRN4/0 at 6.5', with calcareous			
		SS			nodules, moist to wet.			
- 10 -		SS			modules, moist to wet.	HNu = 0.4 ppm AU		
			3/5	60	Clayey, sandy SILT (ML), grey, with	HNu = 0.0 ppm BZ		
		ı	6/8		calcareous nodules, moist to wet.			
					·			
- 15 -			ļ.,			HNu = 1.7 ppm AU		
			15/25	60	-TILL, Sand (SP) with silty gravel, wet.	HNu = 0.0 ppm BZ		
		55	50 (5")		Total Depth = 20.1 feet.			
					Total Depth = 20.1 leet.			
- 20 -								
- 25 -								
- 30 -								
- 30 -								
- 35 -						,		
					AU – in auger			
 - 40 -					BZ – in breathing zone SS – split spoon sample			
LOG OF WELL MW2-04								

LOCATION: HULMAN ANG, SW of Site 4 DRILLING FIRM: ETI, B. Repinski DATE DRILLED: 10-17-90 GEOLOGIST: T. Aebie/T. Francy

DEPTH	NO	SAMPLE		DEC	DESCRIPTION OF STRATIONARY	001445150
(Ft)	NO.	IYP	BC/6"	REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS
		SS	4/10	85	-Silty CLAY (CL) to clayey SILT (ML), gray	
		SS	14/13		yellow and brown, dry, roots present.	HNu= 0.0 ppm SS
		SS	2/4	70	As above, mottled, with Fe and Mn stains	
		SS	6/6		and nodules, moist.	
- 5 -			2/3	70	-SILT (ML) and CLAY (CL), moist.	
		SS	4/3			
		ŀ				
- 10 -		00	1/0	0.5	Olavar Oli T (MI) areas transported and	
		1	1/2	65	-Clayey SILT (ML), gray, trace very fine sand,	
		33	3/4	 	soft, wet.	
- 15 -				ļ		
		SS	8/50		-TILL, silty Sand (SP) with clay, gravel,	
			(5")		brown, moist to dry.	
			,		,	
					-Total depth = 20.1 feet.	
- 20 -						
				ł		
- 25 -						
				l		
- 30 -						
- 30 -					·	
- 35 -			1			
			1		AU – in auger	
					BZ – in breathing zone	
- 40 -					SS - split spoon sample	
				10	G OF WELL MW4-05	

LOCATION: HULMAN ANG, SW of Site 5 DRILLING FIRM: ETI, B. Repinski DATE DRILLED: 10-17-90 GEOLOGIST: T. Aebie						
DEPTH (Ft)	NO.		IPLE BC/6"	REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS
		ss				
			21/14	60	-FILL and ASPHALT	
			9/10		-Clayey SILT (ML), grey, dry.	
			3/9	55	-CLAY (CL) with Silt (ML), grey and yellow	
- 5 -			9/11		brown, mottled, soft, moist.	
			2/3	80	-As above, iron nodules, very soft, moist to wet.	
		SS	4/4			
- 10 -						
		SS	2/3		 -Clayey SILT (ML), brown to yellow brown,	
			3/3		mottled, very soft, wet.	
- 15 -						
		1	2/3	85	TILL, grey, clayey Silt (ML) with sand and	
		SS	5/5		gravel. 16.5-17' silty Sand (SM), with gravel	
		SS			and cobbles. -As above	
- 20 -		SS			-As above	
- 20 -		33			-Total Depth = 20 FT.	
					10th 20pm = 20 1 11	
- 25 -						
20						
- 30 -		}				
- 35 -						
					<u> </u>	
 - 40 -					AU – in auger BZ – in breathing zone	
- 40 -					SS – split spoon sample	
LOG OF WELL MW5-02						

LOCATION: HULMAN ANG, SW of Site 6 **DATE DRILLED: 10-17-90** DRILLING FIRM: ETI, B. Repinski GEOLOGIST: T. Aebie DEPTH SAMPLE (Ft) NO. TYP BC/6" REC **DESCRIPTION OF STRATIGRAPHY** COMMENTS SS 4/7 70 -TOP SOIL, brown 10YR4/2 to yellow brown HNu= 0.3 ppm AU SS 8/10 10YR5/6, with roots. ---SS 4/4 70 -Very clayey SILT (ML to MH), yellow brown ---HNu = bkgdSS 7/7 5YR6/1 to 10YR 5/1, with black mineral stains 5 SS 1/2 80 2.5YR5/0, with iron nodules and stains SS 4/4 (5YR4/4), moist. ---HNu = bkgd---SS -As above, mottled, moist to wet. ---10 SS 1/1 80 -Clayey SILT (ML), gray to brown 10YR4/3, with HNu = bkgd SS 3/3 --trace sand, soft, wet. ---15 SS 1/2 100 ----TILL, clayey sandy Silt (ML), gray 5Y5/1. HNu = bkgdSS 3/4 20 -Total Depth = 20.2 FT. ---25

SS - split spoon sample

LOG OF WELL MW6-03

BZ - in breathing zone

AU - in auger

- 30

35

40

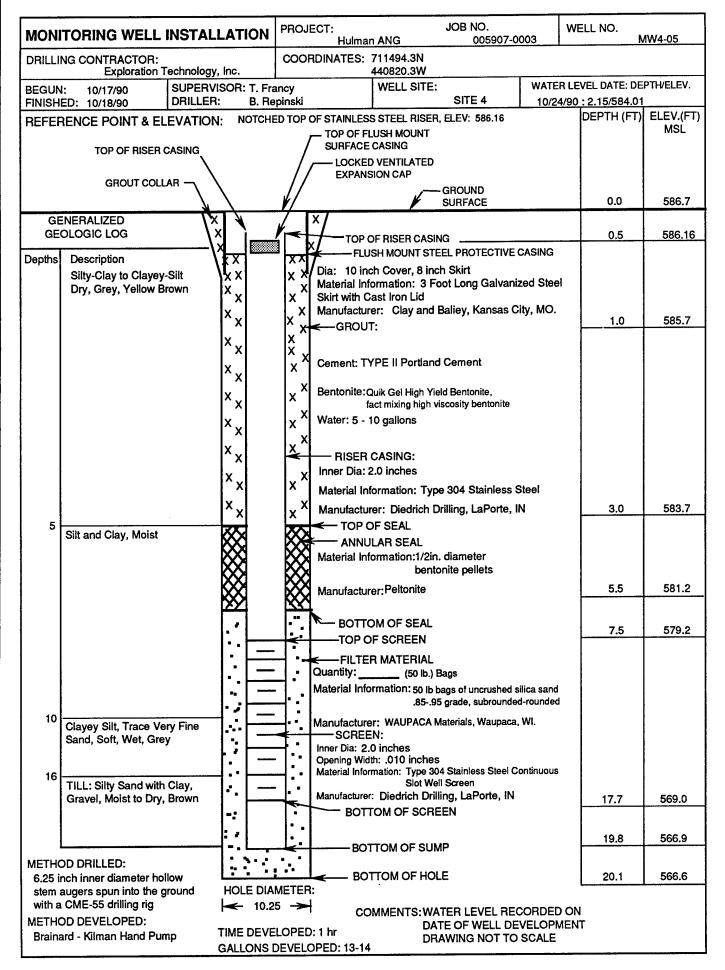
APPENDIX B Piezometer/Monitoring Well Construction Diagrams

MON	TORING WELL INSTA	LLATION	PRO	JECT: Hulmar	n ANG	JOB NO. 005907-00		WELL NO.	1WB-01	
DRILLI	NG CONTRACTOR: Exploration Technology	av. Inc.	coo	RDINATES:		-				
BEGUN		RVISOR: T. Ae	bie pinski		WELL SITE	: d Well BHB-01		LEVEL DATE: DEPTH/ELEV. 4/90 : 2.1/585.95		
	RENCE POINT & ELEVATION		-	OF PVC RISEF	<u> </u>		10/2-4/	DEPTH (FT)	ELEV.(FT)	
,,,,,,	TOP OF RISER CASING	514.			USH MOUNT				MSL	
	GROUT COLLAR —		LOCKED VENTILATED EXPANSION CAP							
	\				F	- GROUND SURFACE		0.0	588.6	
l .	ENERALIZED OLOGIC LOG	\x \ _		X /TOP C	OF RISER CAS	ING -		0.6	588.05	
Depths	Description	-\X 	XX	FLU:	SH MOUNT ST	EEL PROTECTIVE (CASING			
0	Silty Clay, Moist, Brown	XXX	x X x	Dia: 10 ind Material Inf Skirt with C	ast Iron Lid	Foot Long Galvania				
		× x	x X x	Manufactur GROUT	-	Baliey, Kansas C	ity, MO.	1.0	578.6	
2		x x	x,	Cement: TY	PE II Portland	d Cement				
-		××	x X		luik Gel High Yi act mixing high t	eld Bentonite, viscosity bentonite				
		××	x	Water: 5 - 1	10 gallons					
		××	X		CASING:					
		×x	$ _{x}$ x							
		x.)	^ v	, l		pe 304 Stainless S				
		^ x	×	Manufacture TOP O		Orilling, LaPorte, II	N	3.4	585.2	
			\otimes	KQ .	LAR SEAL					
		XX	XX	Material Info	ormation: 1/2i	n. diameter tonite pellets				
		\bowtie	\otimes	Manufacture		toriite peliets		5.4	583.2	
		≫	XX	1						
6	Sandy Silt, Wet, Brown,	7.4			OM OF SEAL			7.6	581.0	
	Mottled	:-	 		FSCREEN					
		. =	7:		R MATERIAL 7 (50 lb.)	Bags				
] :		rmation: 50 lb	bags of uncrushed si 5 grade, subrounded				
10	Fine Sand, Some-Clay,	⊣.∷⊢ =	<u> </u>			Materials, Waupaca,	WI.			
	Plastic, Wet, Light-Brown,	_[; _	7	Inner Dia: 2.0						
45.5	Mottled	_[:. _			th: .010 inches	s 04 Stainless Steel Co	ntinuous	į.		
15.5	TILL: Trace-Pebbles, Dry	7∴	7		Slot We	ell Screen				
	Grey	-:	-		OM OF SCRI	lling, LaPorte, IN EEN		17.8	570.8	
		<u>.</u>								
		┥•.└-	—	ВОТ	TOM OF SU	MР		19.8	568.8	
	DD DRILLED:			_ 007	гтом ог но	I E		20.0	568.6	
stem	nch inner diameter hollow augers spun into the ground	HOLE DIA	METER		I I OIN OF HU	LL		20.0	0.000	
with a	CME-55 drilling rig	10.25	5 ->	d co	MMENTS: W	ATER LEVEL REC	ORDED	ON I		
i .	DD DEVELOPED: ard - Kilman Hand Pump	TIME DEVE	LOPE		DA	TE OF WELL DE	VELOPME		N &	
ומונכ	ao isiman nana rump	GALLONS E			DF	RAWING NOT TO	SUALE		vietcalf & Eddy	

MONITORING WELL INST	TALLATION	PROJE	ECT: JOB NO. Hulman ANG 005907-000		ELL NO.	1W5-02
DRILLING CONTRACTOR: Exploration Techno	ology. Inc.	COOF	RDINATES: 711984.5N 439876.9W			
	ERVISOR: T. Fra	incy	WELL SITE:	WATER L	EVEL DATE: DE	PTH/ELEV.
324011		pinski	SITE 5	10/24/	90 : 5.1/579.5	
REFERENCE POINT & ELEVA	TION: NOTCHE	D TOP C	OF STAINLESS STEEL RISER, ELEV: 584.64		DEPTH (FT)	
		,	TOP OF FLUSH MOUNT		1	MSL
TOP OF RISER CASIN	3	/	SURFACE CASING			
		_ / /	LOCKED VENTILATED EXPANSION CAP			
GROUT COLLAR	\ \		GROUND			
		<u> </u>	SURFACE		0.0	585.2
GENERALIZED	1× 1	4	×/			504.64
GEOLOGIC LOG	_\X		TOP OF RISER CASING		0.6	584.64
epths Description	\\ \ \\	" XX	FLUSH MOUNT STEEL PROTECTIVE CA	SING		
Asphalt and Fill	\x	x	Dia: 10 inch Cover, 8 inch Skirt Material Information: 3 Foot Long Galvanize	d Steel		
	× _x	$ \mathbf{x} $	Skirt with Cast Iron Lid			
ł	l _v l	l xl	Manufacturer: Clay and Baliey, Kansas City	, MO.	1	504.0
	^×	X X	GROUT:		1.0	584.2
	x.,	x ^				
	^ x	x x	Cement: TYPE II Portland Cement			,
	× _x	X	Cement: 117 L 117 Orband Comont			
<u> </u>	1 1	x	Bentonite: Quik Gel High Yield Bentonite,			
	× _×	x	fact mixing high viscosity bentonite			
	x	$ \mathbf{x} $	Water: 5 - 10 gallons			
1	^ x	$ ^{x} $	-			
	[x],	×^	RISER CASING:			
1	^ x		Inner Dia; 2.0 inches			
	× _×	x	Material Information: Type 304 Stainless Ste	ام		
	$ \mathbf{x} $	^ v		G!		582.2
	^×	x ^	Manufacturer: Diedrich Drilling, LaPorte, IN		3.4	562.2
3.0 Clayey Silt, Dry, Grey	XX	XX	TOP OF SEAL			
0.12,0, 0.11, 2.1, 0.10,	 	XX	ANNULAR SEAL			
4.0 Clay with Silt, Soft, Moist, C	rev XX		Material Information:1/2in. diameter bentonite pellets			
and Yellow Brown, Mottled			•		5.4	579.7
	DXXI		Manufacturer: Peltonite		J.4	070.7
	$\overline{\mathbf{x}}$	1				
	.		BOTTOM OF SEAL		7.6	577.6
	• •	-	TOP OF SCREEN			
	<u> </u>	┥╹┥	FILTER MATERIAL			
			Quantity: 9 (50 lb.) Bags		1	
Clayey-Silt, Very Soft, Wet		۱. ا	Material Information: 50 lb bags of uncrushed silic	a sand	1	
Brown to Yellow Brown,	· ; <u> </u>	┥:	.8595 grade, subrounded-ro			
Mottled	_ _	-ŀ·. l	Manufacturer: WAUPACA Materials, Waupaca, W	i.		
	-	₹.				
		T • •	Inner Dia: 2.0 inches Opening Width: .010 inches			
		- :•	Material Information: Type 304 Stainless Steel Cont	inuous		
15 TILL: Clayey Silt with Sand	 •.	. •	Slot Well Screen			
and Gravel, Grey	 	-	Manufacturer: Diedrich Drilling, LaPorte, IN		17.8	567.4
16.5 Silty Sand, with Gravel and	 • ;	:	BOTTOM OF SCREEN			
Cobbles	' : •				19.8	565.4
		-	BOTTOM OF SUMP			
METHOD DRILLED:			POTTOM OF UCLE		1 200	565.2
6.25 inch inner diameter hollow	HOLE DIA	METER	BOTTOM OF HOLE		20.0	965.2
stem augers spun into the ground with a CME-55 drilling rig	HOLE DIA					
METHOD DEVELOPED:	10.2	· —	COMMENTO: WATER LEVEL RECO			
Brainard - Kilman Hand Pump	TIME DEVE	LOPED	DATE OF WELL DEVE		11	
Diamaiu - Millian Hanu Fullip	GALLONS I	DEVELO	OPED: 12 DRAWING NOT TO SC	JALE		INDIVERSI OF EX

MONITORING WELL INSTA	LLATION	PRO.	JECT: Hulman AN	VG	JOB NO. 005907-0		WELL NO.	MW6-03
DRILLING CONTRACTOR: Exploration Technological	av. Inc.	coc	RDINATES: 7119	900.6N 624.1W				
BEGUN: 11:35 10/17/90 SUPER	RVISOR: T. Fra	ancy		ELL SITE:		WATER L	EVEL DATE: 0	EPTH/ELEV.
FINISHED: 12:45 10/17/90 DRILLI		pinski			SITE 6	10/24/9	0 : 5.4/580.4	
REFERENCE POINT & ELEVATION	ON: NOTCHI	ED TOP	OF STAINLESS ST		R, ELEV: 585.81		DEPTH (F	T) ELEV.(FT) MSL
TOP OF RISER CASING		/	SURFACE CAS LOCKED VEI	SING				
CROUT COLLAR			EXPANSION					
GROUT COLLAR —	_ \	//		1	-GROUND SURFACE		0.0	586.4
GENERALIZED	X	1	x/					
GEOLOGIC LOG	\ <u>`</u> \`\	∕ '	X TOP OF R	RISER CASI	NG		0.6	585.81
Depths Description	*X	_ X X	17		EEL PROTECTIVE (CASING		
Top Soil: with Roots, Brown to Yellow-Brown	\ <u>k</u> x	x X	Dia: 10 inch C		ch Skirt oot Long Galvani:	zad Staal		
Brown to renow-Brown	x x	x ^	Skirt with Cast		out Long Garvaria	zeu Steet		
Ì	××	×	Manufacturer:		Baliey, Kansas C	ity, MO.	1.0	585.4
		X X	GROUT:				1.0	303.4
	$ \mathbf{x}_{\mathbf{x}} $	X X	}					
1	l _v l	x	Cement:TYPE	Il Portland	l Cement			ļ
	^ x	_ ``↓						
2	x _x	x ^	Bentonite: Quik		eld Bentonite, viscosity bentonite			
Clayey-Silt, Iron Nodules,		x	Water: 5 - 10 ga		viscosity bentonite			
Yellow Brown, with Black Mineral Stains	X x			alions				
Willeral Stairts	x	X X						
	^ x		RISER CAS					
	x x	$ _{x}$ x			304 Stainless Steel			
ł		- I''			rilling, LaPorte, IN			
	××	$ x ^{x}$			ming, Lai Oite, in	•	3.2	583.2
	XX	XX	TOP OF S					
	XX	X	ANNULAR					
		XX	Material Informa		. diameter onite pellets			
	\otimes	XX			Jilite peliets			500.0
	XX	₩.	Manufacturer: P	Peltonite			5.5	580.9
6 As Above, Wet	- 7,		воттом с	OF SEAL				
As Above, Wet	:		TOP OF SO				7.6	578.8
	• =	_ ∵_	FILTER M	ATERIAL				
	<u> </u>		Quantity: 7		Bags			
		╗.			pags of uncrushed si	lica sand		
	. ;	- :		.859	5 Grade, subrounder	d-rounded		
10 Clayey-Silt, Trace Sand,	⊣.:.├ ─	-ŀ• .	Manufacturer: Re	ed Flint Filte	r Sands & Gravel			
Soft Wet, Grey-Brown		┽.	SCREEN:					
	<u> </u>	1	Inner Dia: 2.0 inc Opening Width: .0					
	:	- :∙			4 Stainless Steel Co	ntinuous		
16	· .			Slot Wel		nandous		
TILL: Clayey-Sandy-Silt, Grey	77	T.	Manufacturer: Die	edrich Drill	ing, LaPorte, IN		17.8	568.6
		.	ВОТТОМ	OF SCRE	EEN			
	ᆜ : <u>'</u>	<u>.</u>	POTTO:	M OF SUN	1Þ		19.8	566.6
METHOD DRILLED:	1.	• • •		W OF 301	m			
6.25 inch inner diameter hollow		•	ВОТТОІ	M OF HO	LE		20.2	566.2
stem augers spun into the ground	HOLE DIA	METER	₹:					
with a CME-55 drilling rig	10.2	5 ->	COMM	ENTS:WA	TER LEVEL REC	ORDED	ON	
METHOD DEVELOPED:	TIME DEVE	ו חפבי	D: 30 Minutes	DA	TE OF WELL DE	VELOPME		NX=
Brainard-Kilman Hand Pump	GALLONS [DR	AWING NOT TO	SCALE		Metcalf & Edd,

NUON	ITORING WELL INST	ALLATION	PRO	ECT: JOB NO. Hulman ANG 005907-0003	WELL NO.	/W2-04
DRILL	ING CONTRACTOR: Exploration Techno	logy Inc	coo	RDINATES: 711449.8N 439981.7W		
BEGUI	l ou m	RVISOR: T. Fr	ancv		ER LEVEL DATE: DEF	
			pinski	SITE 2	10/24/90 : 2.40	
REFE	RENCE POINT & ELEVAT	ION: NOTCH	D TOP	OF STAINLESS STEEL RISER, ELEV: 581.89	DEPTH (FT)	ELEV.(FT)
	TOP OF RISER CASING	<u>.</u>		TOP OF FLUSH MOUNT SURFACE CASING		WISE
	TOP OF MISER OAGING			LOCKED VENTILATED EXPANSION CAP		
	GROUT COLLAR —	\ \		GROUND SURFACE	0.0	582.4
	ENERALIZED	1×1	1	×/		
GE	EOLOGIC LOG	_\X		TOP OF RISER CASING	0.5	<u>581.89</u>
Depths	Description	\ k ×	XX	FLUSH MOUNT STEEL PROTECTIVE CASING	3.0	579.4
		\x x	X X	Material Information: 3 Foot Long Galvanized St	eel	
		^×	X.	Skirt with Cast Iron Lid		
		x x	x X	Manufacturer: Clay and Balley, Kansas City, Mo ——GROUT:	1.0	581.4
		1 (x x	anou1.	1.0	55111
		××	X	Cement: TYPE II Portland Cement		
^		× _x	ΧÍ	Centerit. 1172 ii Fottand Gement		
2	Very Silty-Clay, Dry, Grey	x	_x x	Bentonite: Quik Gel High Yield Bentonite,		
		×x	^ x	fact mixing high viscosity bentonite		
		x x	X	Water: 5 - 10 gallons		
			××			
		×x	-	RISER CASING: Inner Dia: 2.0 inches		
		× _×	$ _{x}$ $ _{x}$	Material Information: Type 304 Stainless Steel		
		x.	×	Manufacturer: Diedrich Drilling, LaPorte, IN	3.0	579.4
		Ľ×	X	TOP OF SEAL	3.0	073.4
			\otimes	ANNULAR SEAL		
4	Silty-Clay, Moist, Yellow-Bro	own 💥	XX	Material Information: 1/2in. diameter		
	to Grey	XXI	\Diamond	bentonite pellets		
			\otimes	Manufacturer: Peltonite	5.2	577.2
6	Clay and Silt, Moist, Wet	•		BOTTOM OF SEAL	7.5	E74.0
	Yellow Brown to Grey with	:.	+	TOP OF SCREEN	7.5	574.9
	Calcium Nodules	• =	┧.	FILTER MATERIAL		
			_ ։	Quantity: <u>5 1/3</u> (50 lb.) Bags		
			_	Material Information: 50 lb bags of uncrushed silica sa .8595 grade, subrounded-round		
10			_	Manufacturer: WAUPACA Materials, Waupaca, WI.		
10	Clayey-Sandy-Silt, Moist-W		┽	SCREEN:		
	with Calcium Nodules, Grey		T. .	Inner Dia: 2,0 inches Opening Width: .010 inches		
		-	- : ⋅	Material Information: Type 304 Stainless Steel Continuo Slot Well Screen	ıs	
16	TILL: Sand with Silty-Grave			Manufacturer: Diedrich Drilling, LaPorte, IN	17.8	564.7
	Wet	" -:		BOTTOM OF SCREEN		
			• •		19.7	562.7
		: •	1 -			
		:.		BOTTOM OF SUMP	10.7	302.7
	OD DRILLED:					
6.25 i	inch inner diameter hollow		METER	BOTTOM OF HOLE	20.1	562.3
6.25 i stem	inch inner diameter hollow augers spun into the ground	HOLE DIA		BOTTOM OF HOLE	20.1	
6.25 i stem with a	inch inner diameter hollow	HOLE DIA	5 →	BOTTOM OF HOLE COMMENTS: WATER LEVEL RECORD	20.1 ED ON	



MON	TORING WELL INSTAL	LATION	PROJ	IECT: Hulman ANG	JOB NO. 005907-00		WELL NO.	/W1-06	
DRILLI	NG CONTRACTOR: Exploration Technology	, Inc.	coo	RDINATES: 710798.2N 446184.5W					
BEGUN			ancy	WELL SITE	:		EVEL DATE: DEI		
	ED: 07:35 10/17/90 DRILLER	: B. Re	pinski		SITE 1	10/24	/90 : 3.0/580.33		
REFER	RENCE POINT & ELEVATION	: иотсн	ED TOP	OF STAINLESS STEEL RISE	R, ELEV: 583.33		DEPTH (FT)	ELEV.(FT MSL	
				TOP OF FLUSH MOUNT SURFACE CASING				WOL	
	TOP OF RISER CASING		/	LOCKED VENTILATED)				
			- //	EXPANSION CAP					
	GROUT COLLAR —\		_//	/-	GROUND			500.0	
	*		<u> </u>	<i>y</i>	SURFACE		0.0	583.9	
	ENERALIZED XX OLOGIC LOG		1	TOP OF RISER CAS	SING —		0.6	583.33	
			á	√ /	TEEL PROTECTIVE (ASING			
epths	Description	XX	XX	I		Adiita			
	Silty Clay, Mineral Stains Gray and Yellow, Brown	\%×	X	Dia: 10 inch Cover, 8 in Material Information: 3	non Skiri Foot Long Galvaniz	ed Steel			
	Gray and Yellow, Brown	$ \mathbf{x} $	x ^	Skirt with Cast Iron Lid					
		$ x_x $	$ _{x}$ x	Manufacturer: Clay and	d Baliey, Kansas Ci	ty, MO.	1,0	582.9	
			x X	GROUT:					
		x x	Ϊ́α,						
		x x	x^	Cement: TYPE II Portlar	d Cement				
2			l x	Bentonite: Quik Gel High `	Vield Rentonite				
-	Clayey - Silt, Trace Fine to	x x	x ^		viscosity bentonite		İ		
	Medium Sandy Fe Concretions		_x x	Water: 5 - 10 gallons					
	Moist, Becomes Wet, Grey-Yellow-Brown	×x		_ ·					
	Clay Tallow Blown	××	X X	RISER CASING:					
		I I	1	Inner Die: 2 0 inches					
		× x	x X	Material Information: Ty	pe 304 Stainless S	teel			
		×x	X	Manufacturer: Diedrich			3.2	580.7	
		L	X	TOP OF SEAL	Diming, Late of to, in	•			
		\bigotimes	₩.	ANNULAR SEAL					
			XX	Material Information: 1/2					
		XX	\mathbb{Z}	ber	ntonite pellets				
		∞	∞	Manufacturer: Peltonite			5.5	578.4	
		∞	XX	1					
				BOTTOM OF SEAL			7.6	576.3	
		· . <u> </u>		TOP OF SCREEN					
		l'.		FILTER MATERIAL					
		· . —	: ։	Quantity: 6 2/3 (50 lb.)					
		l •. L□	_} ·	Material Information: 50 lb	bags of uncrusned si 95 grade, subrounded	rounded	1		
10		:	•	Manufacturer: WAUPACA					
	As Above, Wet		-	SCREEN:	Materials, Waupaca,	****			
		│	┥.	Inner Dia: 2.0 inches					
		• =		Opening Width: .010 inche Material Information: Type 3	es 104 Stainless Steel Co	ntinuous			
15	TILL: Clay with Silt, Sand and	:: =	7	Slot W	ell Screen				
	Fine Medium-Gravel	·	-	Manufacturer: Diedrich Dr	•		17.8	566.1	
	Dense, Brown and Grey	-:		BOTTOM OF SCR	IEEN				
		: •	: •				19.8	564.1	
		┪╸┖—		BOTTOM OF SU	MP				
	DD DRILLED:			воттом об но	ИE		20.1	563.8	
6.25 li	nch inner diameter hollow augers spun into the ground	HOLE DIA	METER	·	riole		20.1	303.0	
				i					
stem a	CME-55 drilling rig	10.2	5 →	COLUMNITO.W	ATED I EVEL DEC		N -		
stem a	DD DEVELOPED:	TIME DEVE	5 ->-	D/	ATER LEVEL REC			XX=	

MONITORING WELL INSTALL	ATION	PROJ	ECT: Hulmar	n ANG	JOB NO. 005907-00		WELL NO.	P-01
DRILLING CONTRACTOR: Exploration Technology, In	nc.	coo	RDINATES:					
BEGUN: 15:00 9/27/91 SUPERVISO FINISHED: 17.12 9/27/91 DRILLER:				WELL SITE:	P-1		EVEL DATE: DEPTH/ELEV.) : 3.90/581.42	
REFERENCE POINT & ELEVATION:			TOP OF FL	R, ELEV: 585.33 USH MOUNT	2		DEPTH (FT)	ELEV.(FT) MSL
TOP OF RISER CASING				CASING VENTILATED SION CAP				
GROUT COLLAR —	\		EXPAINS	SION CAP	- GROUND SURFACE		0.0	585.7
GENERALIZED X GEOLOGIC LOG X	4		X TOP	OF RISER CAS	ING		0.4	585.32
Top Soil: Silty Loam with Rootlets, Dry, Brown to Yellow-Brown	XX XX XX XX	x x x x x x x x	Dia: 10 inc Material Info Skirt with Ca Manufacture	th Cover, 8 incormation: 3 Fo ast Iron Lid	EEL PROTECTIVE (ch Skirt oot Long Galvaniz Baliey, Kansas Ci	ed Steel		
Silty Clay to Very Clayey-Silt, Concretions, Moist Becomes Wet at 5 Feet, Black Mineral Stains Mottled Grey and	× x × x × x	x x x x x x	GROUT Cement: TY Bentonite: 0	PE II Portland Quik Gel High Yi act mixing high v			1.0	584.7
	× x x x x x x x x x x x x x x x x x x x	x x x x	RISER (CASING: I.5 inches ormation:Flus	h Jointed, Thread edule 40 PVC	led	5.9	579.8
	×	×	ANNU Material Info	LAR SEAL ormation: 1/2ir bent	rilling, LaPorte, IN n. diameter tonite pellets			
	X	₩	Manufactur				8.0	577.7
As Above, Wet			TOP O FILTER Quantity: Material Info	#30, s	pags of uncrushed sil ubrounded-rounded	lica sand	9.9	575.8
Pebbles, Trace-Organic Matter, Wet Becomes Dry at 20'			SCREE Inner Dia: 1.5 Opening Widt Material Infon Manufacturer	N: 5 inches h: 10 Slot mation: Schedul : Diedrich Drill	ling, LaPorte, IN		19.6	566.1
				TOM OF SCRI			19.9	565.8
METHOD DRILLED: 6.25 inch inner diameter hollow stem augers spun into the ground with a CME-55 drilling rig	IOLE DIAM	METER	?: !	TOM OF HO			20.1	565.7
METHOD DEVELOPED: Bailer TI		OPED): 45 Minutes	DA	ATER LEVEL REC TE OF WELL DE' AWING NOT TO	VELOPME		Metcali & Eddy

EGUN: 08:58 9/30/90 SUPERVISOR: T. Francy INISHED: 10:50 9/30/90 DRILLER: B. Repinski EFFERENCE POINT & ELEVATION: NOTCHED TOP OF PVC RISER TOP OF RISER CASING. TOP OF RISER CASING.	40347.9W WELL SITE: WATER LEVEL DATE: DE 10/9/90 : 5.3/581	PTH/ELEV.
EGUN: 08:58 9/30/90 SUPERVISOR: T. Francy INISHED: 10:50 9/30/90 DRILLER: B. Repinski EFERENCE POINT & ELEVATION: NOTCHED TOP OF PVC RISER TOP OF RISER CASING TOP OF RISER CASING LOCKED EXPANSI	P-2 10/9/90 : 5.3/581	PTH/ELEV.
TOP OF RISER CASING TOP OF RISER CASING TOP OF RISER CASING TOP OF RISER CASING TOP OF RISER CASING TOP OF RISER CASING		
TOP OF FILE SURFACE COLORED LOCKED		
TOP OF RISER CASING SURFACE C LOCKED EXPANSI	, LLLT. 665.16	MSL
LOCKED EXPANSI		
GROUT COLLAR — \ / /	VENTILATED ON CAP	
	GROUND SURFACE 0.0	587.1
GENERALIZED X		
	F RISER CASING0.3	586.75
enths Description VXX FFLUS	SH MOUNT STEEL PROTECTIVE CASING	
Top Soil: Clayey Coam, Still, X X X Y Motorial Info	h Cover, 8 inch Skirt ormation: 3 Foot Long Galvanized Steel	
Brown to Yellow X X X Skirt with Ca	ast Iron Lid	
X Manufacture	er: Clay and Baliey, Kansas City, MO.	
^X X GROUT	1.0	586.1
x _x x		
Silty Clay, Stiff, Plastic, Moist, X X Cement: TYF	PE II Portland Cement	
	wile Call High World Dombonito	
	uik Gel High Yield Bentonite, ct mixing high viscosity bentonite	
	• • •	
X X X Water: 5 - 10		
X X RISER C	ASING:	
5 X Material Info	mation:Flush Jointed, Threaded Schedule 40 PVC	
	or: Diedrich Drilling, LaPorte, IN	581.6
	AR SEAL	
	rmation: 1/2in. diameter	
	bentonite pellets	
Manufacture	r: Peltonite 7.9	579.2
8 Sandy-Clay, Increasing Sand		
with Depth, Stiff Plastic,	M OF SEAL 10.2	576.9
	SCREEN	
	MATERIAL 5 (50 lb.) Bags	}
Medium-Fine-Sand	mation:50 lb bags of uncrushed silica sand	
with pebbles and Trace-Clay,	#30, subrounded-rounded	
14.5 Moist Manufacturer	: Red Flint Filter Sands & Gravel	
15.0 SCREEN		
Pebbles, Hard, Dry Opening Width		
Material Inform	ation: Schedule 40 PVC	
Manufacturer:	Diedrich Drilling, LaPorte, IN	567.2
вотто	DM OF SCREEN	367.2
1° 1 1° 1	TOM OF SUMP	566.9
IETHOD DRILLED:		1
0.20 Inch in itel diameter honor	TOM OF HOLE 20.2	566.9
stem augers spun into the ground HOLE DIAMETER: with a CME-55 drilling rig 10.25		
· CON	MMENTS: WATER LEVEL RECORDED ON DATE OF WELL DEVELOPMENT	MXE
IETHOD DEVELOPED: Railer TIME DEVELOPED: 45 Minutes	DATE OF WELL DEVELOPINENT	

MONITORING WELL INSTALLATION	PROJECT:	JOB NO. ANG 0059	907-0003	WELL NO.	P-03		
DRILLING CONTRACTOR: Exploration Technology, Inc.	COORDINATES:						
BEGUN: 10:15 9/27/90 SUPERVISOR: T. Fr.	ancy epinski	WELL SITE: P-3	1	R LEVEL DATE: DE 30/90 : 6.0/579.0	LEVEL DATE: DEPTH/ELEV.		
	ED TOP OF PVC RISER, ELEV: 585.06			DEPTH (FT)			
TOP OF RISER CASING	TOP OF FL SURFACE	USH MOUNT CASING			MSL		
	LOCKED						
GROUT COLLAR —		GROUND SURFACE		0.0	585.7		
GENERALIZED X X X X X X X X X X X X X X X X X X X	X/ TOP C	OF RISER CASING		0.6	585.06		
Depths Description	18.417.	SH MOUNT STEEL PROTEC	TIVE CASING				
\\ <u>\</u> x×	A A Material lef	ch Cover, 8 inch Skirt ormation: 3 Foot Long Ga	alvanized Steel				
	χ ^ Skirt with C						
[×] x	X Manufactur	•	sas Oity, WO.	1.0	584.7		
× _x	X]						
x x		PE II Portland Cement					
		Quik Gel High Yield Bentonite,					
x	'	act mixing high viscosity bent	onite				
× _x	X Water: 5 - 1	IU galions					
x _x	X RISER	CASING:					
$ \mathbf{x}_{x} $	x Inner Dia: 1	.5 inches					
	1 1	ormation:Flush Jointed, T Schedule 40 PV					
x x	X Manufactur	er:Diedrich Drilling, LaPoi F SEAL		5.8	579.9		
I I	Y X XI	DF SEAL LAR SEAL					
I I 🔯		ormation: 1/2in. diameter					
	₩	bentonite pellets	5				
	Manufacture	er: Peltonite		7.9	577.8		
	вотто	OM OF SEAL			E7E 0		
15 Clay, Brown to Yellow, Graded	TOP O	F SCREEN		9.9	575.8		
to Silty Clay, with Some Sand		R MATERIAL 6.5 (50 lb.) Bags					
20 TILL: Fine Sand, Some Clay		o.o (50 lb.) Bags rmation:50 lb bags of uncrus	shed silica sand				
and Silt, Trace Gravel, Moist, becomes Dry	Ⅎ ∶Ӏ	#30, subrounded-ro	unded				
	Manufacture SCREE	r:Red Flint Filter Sands & Gra	avel				
	Inner Dia: 1.	5 inches					
:.		h: .010 inches mation: Schedule 40 PVC					
/. -	Manufacturer	Diedrich Drilling, LaPorte	, IN	40.0	500.4		
	вотт	OM OF SCREEN		19.6	566.1		
	:•			19.9	565.8		
METHOD DRILLED:	BOT	TOM OF SUMP		13.3	300.0		
METHOD DRILLED: 6.25 inch inner diameter hollow	BO1	TOM OF HOLE		20.2	565.5		
stem augers spun into the ground HOLE DIA	METER:						
with a CME-55 drilling rig 40.2 METHOD DEVELOPED:	5 > CO	MMENTS: WATER LEVEL					
Bailer TIME DEVE	LOPED: 45 Minutes	DATE OF WEL DRAWING NO		CN I	Hetcelf & Eddu		
GALLONS	DEVELOPED: 12				•		

MONITORIN	G WELL IN	ISTALLATION	PROJ	Hulman ANG 005907-0003		ELL NO.	-04
RILLING CON	RACTOR: Exploration Ted	chnology, Inc.	COOF	RDINATES: 711752.3N 441089.5W			
EGUN: 13:15	9/26/90	UPERVISOR: T. F	rancy	WELL SITE: W/		/EL DATE: DEP	
INISHED: 09:15			Repinski	P-4	9/30	/90 : 6.95/576	
REFERENCE F	POINT & FLE	VATION: NOTC	HED TOP	OF PVC RISER, ELEV: 587.21		DEPTH (FT)	
ICI CHLINOL I	Olivi & LLL	VALIOIT.		TOP OF FLUSH MOUNT			MSL
TC	P OF RISER CA	SING	/	SURFACE CASING			
				LOCKED VENTILATED EXPANSION CAP			
ı	GROUT COLLAF	' \		GROUND		0.0	587.7
GENERALIZ	ZED	1×1/	// T	×/	•		
GEOLOGIC	LOG	\×	_/ -	TOP OF RISER CASING		0.5	587.2
		\X □		FLUSH MOUNT STEEL PROTECTIVE CAS	ING	j	
epths Descrip		\ ! X	XX	Dia: 10 inch Cover, 8 inch Skirt			
Yellow E	Silt, Grey to	\\ ×	×	Material Information: 3 Foot Long Galvanized	Steel		l
Yellow E	srown	× _x		Skirt with Cast Iron Lid			
			X	Manufacturer: Clay and Baliey, Kansas City,	MO.		F00.7
		x x	X X	€—GROUT:		1.0	586.7
		l _V l	x ^				<u> </u>
		X	X X				
ţ		x x	lx 1	Cement: TYPE II Portland Cement]	}
2 Silby-Cla	y, Increasing S	ilt X X	x ^	Bentonite: Quik Gel High Yield Bentonite,		1 1	l
	th, Moist, Grey			fact mixing high viscosity bentonite			
Yellow B		x x	x ^	Water: 5 - 10 gallons			
		X	l x				
		× _x	×.			1	i
ļ		1 1		Inner Dia: 1.5 inches			
5		× _x	$ _{x} ^{x}$	Material Information: Flush Jointed, Threaded			
As Abov	e, Wet	1 1	^	Schedule 40 PVC			
		× _x	$ _{x} ^{x}$	Manufacturer: Diedrich Drilling, LaPorte, IN		5.75	581.9
		انهوا	× ×	TOP OF SEAL			
		1XX	- XX	ANNULAR SEAL			
		XX	∞	Material Information:1/2in. diameter			
		∞		bentonite pellets		1	
		XX		Manufacturer: Peltonite		8.0	579.7
		₩	₩	Mandiacturer. Pettoritte			
		72	7.2				
		1.*	· .	BOTTOM OF SEAL		9.9	577.8
				——TOP OF SCREEN			
		• =		←FILTER MATERIAL			
		-	- .	Quantity: 6.333 (50 lb.) Bags			į
46			=1'	Material Information: 50 lb bags of uncrushed silica	sand		
16 TILL, Cla	ay with sand, si	It and	}•∵	#30, subrounded-rounded]	
	ery Dense, We		- :	Manufacturer: Red Flint Filter Sands & Gravel			
ľ	-						
		1:1	_}.	Inner Dia: 1.5 inches			
		<u>}.′ </u>	_ • •	Opening Width: .010 inches			i
			:∙	Material Information: Schedule 40PVC			i
18		 • -	_ [•]	Manufacturer: Diedrich Drilling, LaPorte, IN			ł
As Abov	e, Dry	'				19.6	568.1
1		-:	•	BOTTOM OF SCREEN			
1		: .				1 400	EC7 0
L				BOTTOM OF SUMP		19.9	567.8
IETHOD DRILL	ED.						
6.25 inch inner		,		BOTTOM OF HOLE		20.0	567.7
6.25 inch inner stem augers sp			AMETER				
SIGUL AUDRIS SD			.25 ->-				
				COMMENTS: WATER LEVEL RECOI	RDED O	N T	
with a CME-55		, , ,	•				-
		•	ELOPED	: 45 Minutes DATE OF WELL DEVE	LOPMEN		$\mathcal{N}_{\mathcal{O}}$

MONITORING WELL	INSTALLATION	PROJECT:	an ANG	JOB NO. 005907-0003		WELL NO. P-05		
DRILLING CONTRACTOR: Exploration	Technology, Inc.	COORDINATES:	: 711433.8N 440208.4W					
BEGUN: 12:50 9/29/90	SUPERVISOR: T. F	rancy Repinski	WELL SITE	: P-5		LEVEL DATE: DEPTH/ELEV. /9/90:1.45/581.64		
FINISHED: 14:35 9/29/90 REFERENCE POINT & E		IED TOP OF PVC RISER, ELEV: 583.09			10/9/	DEPTH (FT)		
TOP OF RISEF		TOP OF I	FLUSH MOUNT E CASING ED VENTILATED				MSL	
GROUT COI	LAR —	EXPA	NSION CAP	- GROUND				
GENERALIZED	*	// x/		SURFACE		0.0	583.5	
GEOLOGIC LOG	\^X\ \	TOF	OF RISER CAS			0.4	583.09	
Depths Description Top Soil, Silty-Clay Damp	ey-Loam, XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	X X Dia: 10 i X Material I X Skirt with X Manufact	inch Cover, 8 in Information: 3 F Cast Iron Lid turer: Clay and	EEL PROTECTIVE C ich Skirt Foot Long Galvaniz I Baliey, Kansas Ci	zed Steel	1.0	582.5	
2 Silty-Clay, Stiff, Dry		^_	TYPE II Portlan			1.0	302.3	
	x x x x x	X RISEF	- 10 gallons R CASING: : 1.5 inches nformation: Flus	h Jointed, Threaded				
	××	TOP ANN	urer: Diedrich [OF SEAL IULAR SEAL nformation:1/2ir	Orilling, LaPorte, IN	I	5.3	578.2	
		Manufacti	urer: Peltonite			7.9	575.6	
9 Silty-Clay, Trace Fi	ne to	1 - 7 1	TOM OF SEAL OF SCREEN			10.1	573.4	
Medium-Sand, Incr Sand with Depth, S Grey	easing	FILTI Quantity:	ER MATERIAL 6.8 (50 lb.) formation: 50 lb	Bags bags of uncrushed sil subrounded-rounded	lica sand			
Till: Sandy-Clay, wi Pebbles, Firm, Wet	· .; =	SCRE Inner Dia: 1 Opening W	rer: Red Flint Filte EN: 1.5 inches lidth: .010 inche	er Sands & Gravel				
As Above, Dry		Manufactur		ling, LaPorte, IN		19.8	563.7	
	-: -:	::	TTOM OF SCR			20.1	563.4	
METHOD DRILLED:			OTTOM OF SU					
6.25 inch inner diameter h stem augers spun into the with a CME-55 drilling rig		AMETER:	OTTOM OF HO			20.1	563.4	
METHOD DEVELOPED: Bailer	TIME DEV	ZELOPED: 45 Minutes DEVELOPED: 12	D/	ATER LEVEL REC ATE OF WELL DE RAWING NOT TO	VELOPME		Metcalf & Eddy	

MONITORING WELL INSTA	LLATION	PROJ	ECT: JOB NO. Hulman ANG 005907-0	1	WELL NO.	-06
ORILLING CONTRACTOR: Exploration Technology	gy, Inc.	COOF	RDINATES: 711086.8N 440856.2W			
	RVISOR: T. Fra	incy	WELL SITE:	WATER L	EVEL DATE: DEPT	TH/ELEV.
INISHED: 11:15 9/28/90 DRILL	ER: B. Re	pinski	P-6	9/30/	90 : 3.30/584.8	
REFERENCE POINT & ELEVATI	ON: NOTCHE	ED TOP	OF PVC RISER, ELEV: 588.10		DEPTH (FT)	ELEV.(FI
		/	TOP OF FLUSH MOUNT SURFACE CASING			
TOP OF RISER CASING			/— LOCKED VENTILATED EXPANSION CAP			
GROUT COLLAR —	. \		GROUND SURFACE		0.0	588.5
GENERALIZED	XX	/ T	×/		0.4	588.10
GEOLOGIC LOG	\ <u>`</u>	/	TOP OF RISER CASING		U.4	000.10
Pepths Description	-\\ \ \\	'lxx	FLUSH MOUNT STEEL PROTECTIVE	CASING		
Top Soil, Slightly Moist,	\\\x x	x x	Dia: 10 inch Cover, 8 inch Skirt Material Information: 3 Foot Long Galvani	zed Steel		
Brown-Grey, Mottled	××	\times	Skirt with Cast Iron Lid		-	
	x^	X	Manufacturer: Clay and Balley, Kansas C	ity, MO.	40	E07 E
2	x x	X X	<grout:< td=""><td></td><td>1.0</td><td>587.5</td></grout:<>		1.0	587.5
Silty-Clay, Concretions,	××	×				
Black Mineral Stains, Moist, Grey to Yellow Brown, Mottle		^ x	Cement: TYPE II Portland Cement			
Moist	d, X	^_				
	××	\times	Bentonite: Quik Gel High Yield Bentonite,			
		x	fact mixing high viscosity bentonite			
	××	X	Water: 5 - 10 gallons			
	ly l	x X				
	^x	~	— RISER CASING: Inner Dia: 1.5 inches			
	x.,	_x x	Material Information: Flush Jointed, Threaded			
	x x	x	Schedule 40 PVC		5.7	582.2
6	_ <u>`</u>	×	Manufacturer: Diedrich Drilling, LaPorte, IN TOP OF SEAL	4		
Clayey-Silt, Soft,	₩		ANNULAR SEAL			
Becomes Wet	XX		Material Information: 1/2in. diameter			
	 XX	\otimes	bentonite pellets			
	lXX1		Manufacturer: Peltonite		7.9	580.6
	<u> </u>	W				
	•	.	BOTTOM OF SEAL		9.9	578.7
As Above, Becomes	∃:.⊢–	-	TOP OF SCREEN		3.5	0,0.,
Very-Clayey,	• =	1∵. ¦	← —FILTER MATERIAL			
Wet, Grey to Yellow Brown	1	J.: 1	Quantity: 7 (50 lb.) Bags			
			Material Information: 50 lb bags of uncrushed si	lica sand		
İ	- -	-i':	#30, subrounded-rounded			
	.:. -	-ŀ•.	Manufacturer: Red Flint Filter Sands & Gravel			
16 Till: Silt and Clay,		₹.				
with Sand and Trace-Gravel,		□••	Opening Width: .010 inches			
Dense, 45° Fracture, Dry at		- ∶-	Material Information: Schedule 40PVC			
16.5', Grey	·. —	. •	Manufacturer: Diedrich Drilling, LaPorte, IN		19.5	569.5
		1	BOTTOM OF SCREEN		19.5	309.3
	••	• .	20,10,11,0,10,11,11			
			BOTTOM OF SUMP		19.8	569.2
METHOD DRILLED:	\	$\overline{\cdot \cdot \cdot}$	BOTTOWIOI SOWIF			
6.25 inch inner diameter hollow	: : :	•	BOTTOM OF HOLE		19.8	569.2
stem augers spun into the ground	HOLE DIAM	METER	:			
with a CME-55 drilling rig	10.25	5 -> 	COMMENTS, WATER LEVEL RE	ORDED	ON	
METHOD DEVELOPED:	TIME DEVE	OPED	DATE OF WELL DE	VELOPMI	ENT	
Bailer			DRAWING NOT TO	SCALE		

MONITORING WELL INSTA	LLATION	PROJE	ECT: Hulman ANG	JOB NO. 005907-0003	W	ELL NO.	P-07
DRILLING CONTRACTOR: Exploration Technology	av. Inc.	COOF	RDINATES: 710931.0N 440049.0W				
	VISOR: T. Fr	ancy	WELL SIT	E: W	ATER LE	VEL DATE: DEF	TH/ELEV.
INISHED: 10:30 9/29/90 DRILLE	R: B. Re	pinski		P-7	10/1/90	: 2.95/579.07	
REFERENCE POINT & ELEVATION	N: NOTCH	ED TOP (OF PVC RISER, ELEV: 582	.02		DEPTH (FT)	
TOP OF RISER CASING		/	TOP OF FLUSH MOUNT SURFACE CASING	ſ			MSL
GROUT COLLAR —			LOCKED VENTILATE EXPANSION CAP	D			
GHOOT COLLAIT		//	V	GROUND SURFACE		0.0	582.4
GENERALIZED GEOLOGIC LOG	×		X TOP OF RISER CA	SING		0.4	582.02
	/×			STEEL PROTECTIVE CAS	NG		
epths Description	XX XX	× × × ×	Dia: 10 inch Cover, 8 Material Information: 3	inch Skirt I Foot Long Galvanized			
	X	[X.]	Skirt with Cast Iron Lid	nd Baliey, Kansas City,	MO		
İ	××	$ \mathbf{x} ^{X}$	-	to balley, Narisas Oity,	IVIO.	1.0	581.4
Silty-Clay, with Black Mineral		x X	<grout:< td=""><td></td><td></td><td></td><td></td></grout:<>				
Stains, Moist, Brown	x x x	X X	Cement: TYPE II Portla	and Cement			
	x x	x X	Bentonite: Quik Gel High fact mixing hig	Yield Bentonite, h viscosity bentonite			
	x x	х×	Water: 5 - 10 gallons	·			
	x x	× ^X	RISER CASING:				
5	_ ×	x X	Material Information: Fi	ush Jointed, Threaded			
As Above, with Trace Fine-Sand	× x	x X	Manufacturer: Diedrich TOP OF SEAL	Drilling, LaPorte, IN		5.4	577.0
			ANNULAR SEAL				
1	XX	XX	Material Information: 1/2				
7	− 882	∞		entonite pellets			
Silty-Clay, Weathered Horizo at 7.5', Small Rocks Present, Some	^ ※	₩	Manufacturer: Peltonite			7.9	574.5
Black Mineral Stains	.*		R— BOTTOM OF SEA			10.0	572.4
Sandy-Clay, Wet at	∃:: ⊑	-	──TOP OF SCREEN <filter materia<="" td=""><td></td><td></td><td></td><td></td></filter>				
11.5 Feet, Grey	.	IJ.: I	Quantity: 6.9 (50 lb				
		<u> </u>	Material Information: 50 #30	lb bags of uncrushed silica), subrounded-rounded	sand		
15	_ .: -		Manufacturer: Red Flint F	ilter Sands & Gravel			
TILL: Interbedded Sand and Sandy Clays, Discontinuous,	-	┽	SCREEN:				
Trace-Pebbles Wet	<u></u> .'	·.	Inner Dia: 1.5 inches Opening Width: .010 inch	100			
As Above, No Pebbles	⊣∴	- :-	Material Information: Sche				
Becomes Dry at 18.5'	· . <u> </u>	<u>-</u>]. •	Manufacturer: Diedrich D	rilling, LaPorte, IN		19.7	562.7
1	\ <u></u>		воттом об вс	REEN		15.7	302.7
	<u> </u> :	• • •	portou of o	LINED		20.0	562.4
METHOD DRILLED:		•	BOTTOM OF S	UIVIP			
6.25 inch inner diameter hollow		• • •	воттом об н	IOLE		20.05	562.35
stem augers spun into the ground with a CME-55 drilling rig	HOLE DIA		1	WATER LEVEL RECO	DED O	N .	
METHOD DEVELOPED:			· COMMENTS:	DATE OF WELL DEVE			XX:
Bailer			1: 45 Minutes	DRAWING NOT TO SC			Metcalf & Ed

MONITORING WELL INSTALLAT	ION PROJE	CT: Hulman ANG	JOB NO. 005907-0003	WELL NO.	P-08		
DRILLING CONTRACTOR: Exploration Technology, Inc.	COORI	COORDINATES: 710669.6N 440394.0W					
BEGUN: 13:40 9/28/90 SUPERVISOR FINISHED: 16:35 9/28/90 DRILLER:	T. Aebie B. Repinski	oie WELL SITE: WATE		R LEVEL DATE: DEPTH/ELEV. 1/1/90 : 4.20/580.5			
111101120110100 0.20.00	<u>-</u>	F PVC RISER, ELEV: 584.7		DEPTH (FT)	ELEV.(FT)		
TOP OF RISER CASING	_	- TOP OF FLUSH MOUNT SURFACE CASING			MSL		
GROUT COLLAR —	//	LOCKED VENTILATED EXPANSION CAP	•				
GHOOT GOLDAN	· //	F	GROUND SURFACE	0.0	585.0		
GENERALIZED X GEOLOGIC LOG X	X	TOP OF RISER CAS	NING	0.3	584.70		
Donatha Description X		/	EEL PROTECTIVE CASING				
Depths Description XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	x x x	Dia: 10 inch Cover, 8 in Material Information: 3 F Skirt with Cast Iron Lid Manufacturer: Clay and		1.0	584.0		
Silty-Clay, with Black Mineral X X X X X X X X	^	Cement: TYPE II Portlan Bentonite:Quik Gel High Yi	eld Bentonite,				
x x x x x	x X X	fact mixing high v Water: 5 - 10 gallons RISER CASING: Inner Dia: 1.5 inches Material Information: Flus	viscosity bentonite				
5 X X	l x		edule 40 PVC	5.0	580.0		
As Above, Becomes Grey at 5.5' Mottled, Moist		← TOP OF SEAL ANNULAR SEAL Material Information:1/2ir					
		Manufacturer: Peltonite	,	7.7	577.3		
9 Clayey-Medium Sand		BOTTOM OF SEAL		10.2	574.8		
Silt, Moist, Wet at 11', Grey with Brown Mottling		TOP OF SCREEN FILTER MATERIAL					
			Bags bags of uncrushed silica sand subrounded-rounded				
TILL: Silty-Sand, Trace Cobbles, Becomes Dry, Grey		Manufacturer: Red Flint Filte — SCREEN: nner Dia: 1.5 inches Dpening Width: .010 inches Material Information: Schedul	3				
•	1 1	Manufacturer: Diedrich Drilli	ing, LaPorte, IN	20.0	565.0		
-:		BOTTOM OF SCRE		20.3	564.7		
METHOD DRILLED:							
	DIAMETER:	€ BOTTOM OF HOL		20.3	564.7		
METHOD DEVELOPED: Bailer TIME	DEVELOPED: S	35 Minutes DA	ATER LEVEL RECORDED ATE OF WELL DEVELOPM RAWING NOT TO SCALE	IENT	etcalf & Eddy		

APPENDIX C Survey Data and Slug Test Calculations

SURVEY DATA

BH1-14	710871.5	N	440331.5	W	584.80	
EH1-15	710839.8	N	440285.6	W	584.40	
BH2-06	711621.8	N	439977.8	W	583.60	
BH2-07	711632.8	N	440126.5	W	585.60	
BH2-08	711628.3	N	440178.9	W	584.60	
BH2-09	711514.2	N	440019.0	W	583.40	
BH4-10	711613.9	N	440858.5	W	587.19	
BH4-11	711544.1	N	440869.7	W	587.20	
BH4-12	711554.7	N	440966.1	W	587.60	
BH4-13	711573.5	N	441021.1	W	587.94	
BH5-02	712182.0	N	439920.4	W	585.39	
BH5-03	712111.9	N	439936.5	W	585.80	
BH6-04	712093.3	N	439755.4	W	585.90	
BH6-05	712041.9	N	439763.4	W	586.37	
MW1-06	710798.2	N	440184.5	W	583.33	
MW2-04	711449.8		439981.7	W	581.89	
MW4-05	711494.3		440820.3	W	586.16	
MW5-02	711984.5		439876.9	W	584.64	
MW6-03	711900.6	N	439624.1	W	585.81	
MWB-01, BHB-01			440367.2	W	588.05	
PIEZO-01	712372.8		439671.4	W	585.32	
PIEZO-02	712062.5		440347.9	W	586.75	
PIEZO-03	711690.2		439647.7	W	585.06	
PIEZO-04	711752.3		441089.5	W	587.21	
PIEZO-05			440208.4	W	583.09	
PIEZO-06			440856.2		588.10	
PIEZO-07	710931.0				582.02	
PIEZO-08	710669.6		_	W	584.70	
NE COR #37	711204.9			W_	REFERENCE	LINE
SE COR #33	711732.8		440298.0		·····	

SLUG TEST CALCULATIONS

MWB-01

Using method: Bouwer & Rice Water Res., Vol. 12, No. 3, June 1976

a) From semi-log plot (log Y_t vs t)

$$Y_0 = 2.17 \text{ ft.}$$
; at t = 12 sec., $Y_t = 1.80 \text{ ft.}$

so
$$(\frac{1}{t})$$
 $\ln \frac{Y_0}{Y_t} = \frac{1}{12} \sec$. $\ln \frac{2.17}{1.80} = 1.56 \times 10^{-3} \sec^{-1}$

- b) $\frac{L_e}{r_w} = \frac{10.2 \text{ ft.}}{.0833 \text{ ft.}} = 122.4$
- c) From Figure 3, using $\frac{L}{r_{\omega}}$ = 122.4, C=4.8
- d) For fully penetrating well, assume D = H and use equation (9)

$$\ln \frac{R_{\rm e}}{r_{\rm td}} = \left(\frac{1.1}{\ln 17.4 \text{ ft./.0833 ft.}} + \frac{4.8}{10.2 \text{ ft./0.0833 ft.}}\right)^{-1}$$

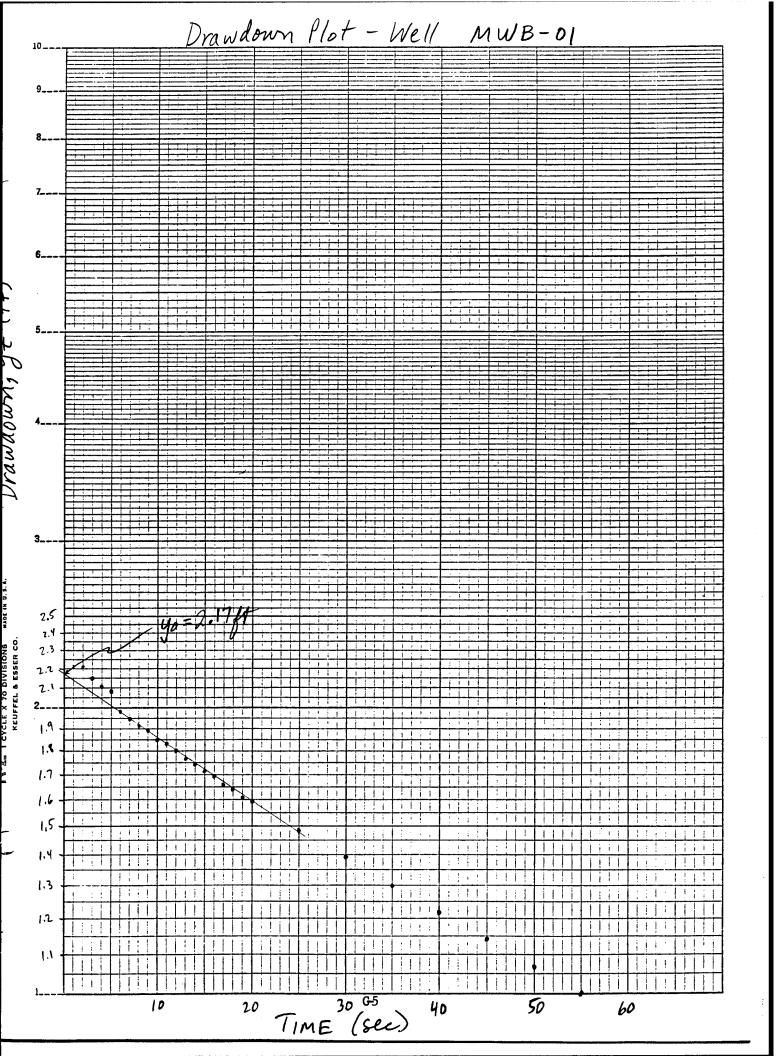
$$= (.0259 + .0392)^{-1} = (.02451)^{-1}$$

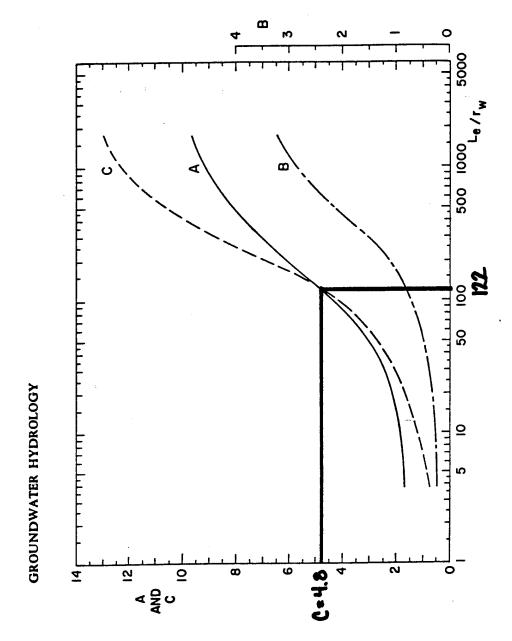
$$\ln \frac{R_e}{r_w} = 4.080$$

e) Using equation (5), $\frac{K = r_c^2 \ln (R_e/r_w)}{2L} (\frac{1}{t}) (\frac{Y_o}{Y_t})$

$$K = \frac{(.0833 \text{ ft})^2 (4.080)}{2 (10.2)}$$
 (1.58 x 10⁻³ sec⁻¹)

$$K = 2.16 \times 10^{-5} \text{ ft./sec.} = 6.6 \times 10^{-4} \text{ cm/sec.}$$



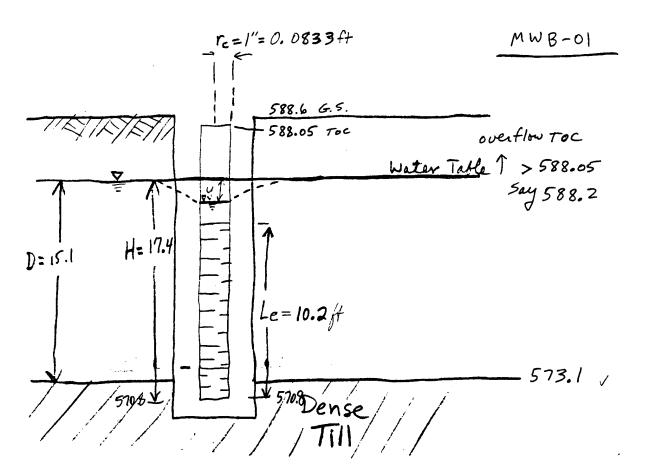


Curves relating coefficients A, B, and C to Le/rw.

Project Hazwrap-Hulman IANG Acct. No. 5907-8

Subject Slug Test Comptd. By TFrancy Date 2-25-91

Detail Mon. Well Details Ck.d. By Date



a) From semi-log plot (log Y_t vs t)

$$Y_0 = 1.77 \text{ ft.}$$
; $t = 14 \text{ sec.}$, $Y_t = 1.73 \text{ ft.}$

so
$$(\frac{1}{t}) \ln \frac{Y_0}{Y_t} = \frac{1}{14} \sec.$$
 $\frac{1.77}{1.73} = 1.63 \times 10^{-3} \sec.^{-1}$

b)
$$\frac{L_e}{r_w} = \frac{10.2}{.0833} = 122.4$$

- c) From Figure 3, using $\frac{L}{r_w}$ = 122.4, C = 4.8
- d) For fully penetrating well, assume D = H and use equation (9)

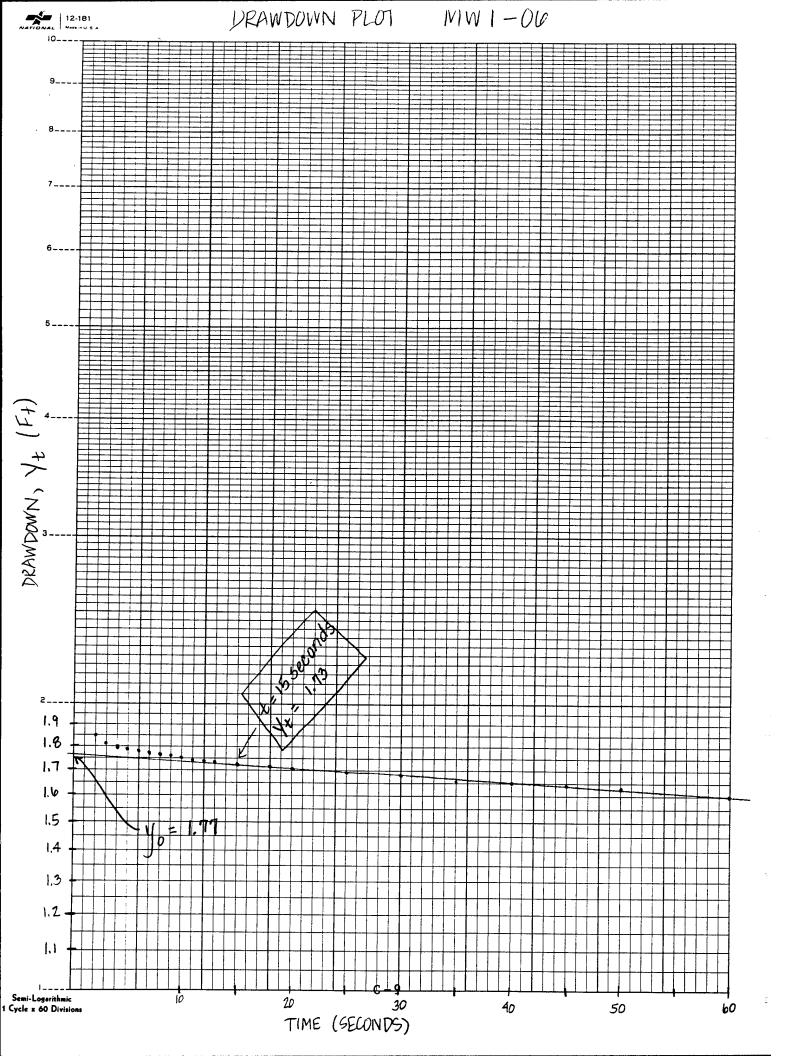
$$\ln \frac{R_e}{r_w} = \left(\frac{1.1}{\ln (15/.0883)} + \frac{4.8}{10.2/.0833}\right)^{-1}$$

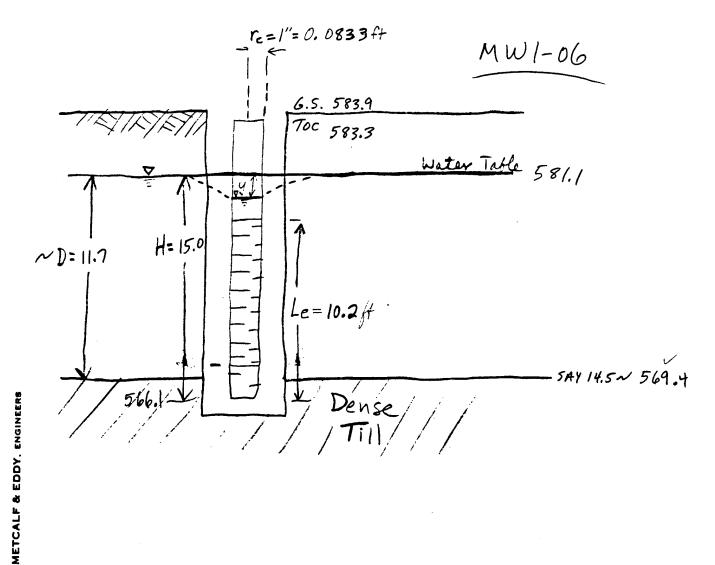
$$\ln \frac{R_e}{r_u} = 3.98$$

e) Using equation (5), $K = \frac{r_c^2 \ln \frac{R_e}{r_w}}{2L} (\frac{1}{t}) (\ln \frac{Y_o}{Y_t})$

$$K = \frac{(.0833 \text{ ft.})^2 (3.98)}{2 (10.2 \text{ ft.})}$$
 (1.63 x 10⁻³ sec.⁻¹)

$$K = 2.21 \times 10^{-6} \text{ ft./sec.} = 6.73 \times 10^{-5} \text{ cm/sec.}$$





a) From semi-log plot (log Y_t vs t)

$$Y_0 = 1.91 \text{ ft.}$$
; t = 20 sec., $Y_t = 1.83 \text{ ft.}$

so
$$\left(\frac{1}{t}\right) \ln \frac{Y_0}{Y_t} = \frac{1}{20} \sec. \left(\ln \frac{1.91}{1.83}\right) = .00214 \sec.^{-1} = 2.14 \times 10^{-3} \sec.^{-1}$$

b)
$$\frac{L_e}{r_w} = \frac{10.2}{.0833} = 122.4$$

- c) From Figure 3, using $\frac{L_e}{r_w} = 122.4$, C = 4.8
- d) For fully penetrating well, assume D = H and use equation (9)

$$\ln \frac{R_e}{r_w} = \left(\frac{1.1}{\ln (15.3/.0833)} + \frac{4.8}{10.2/.0833}\right)^{-1} = .2502^{-1}$$

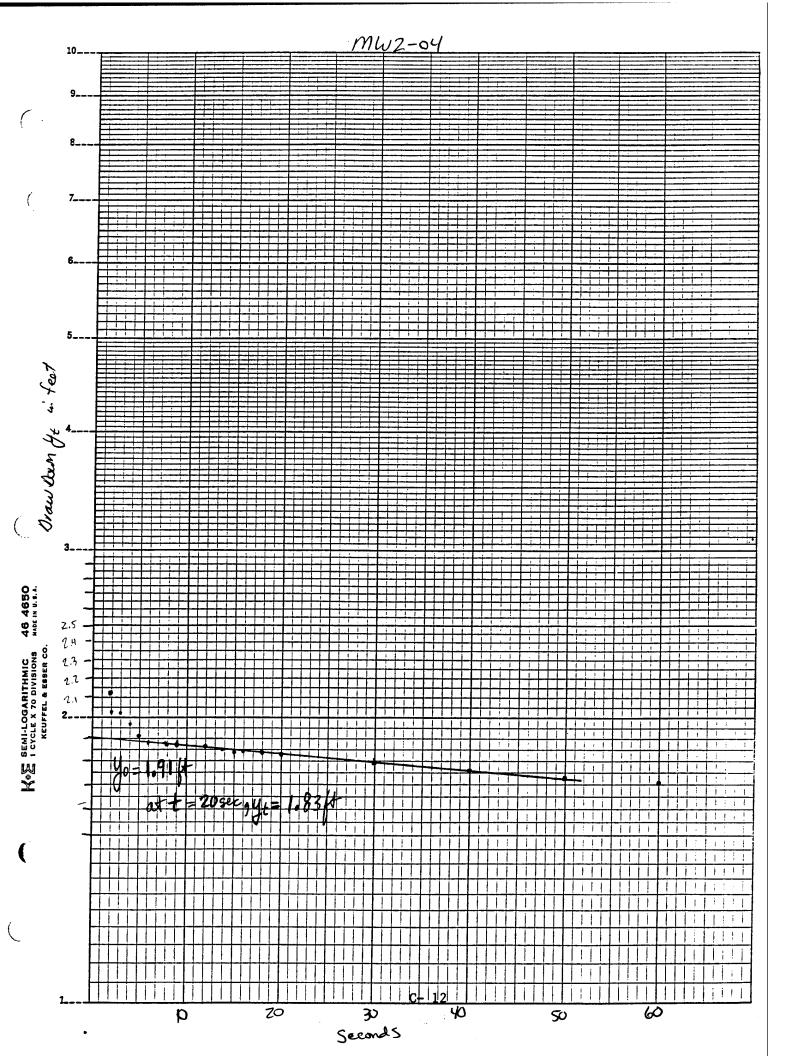
$$\ln \frac{R_e}{r_w} = 4.00$$

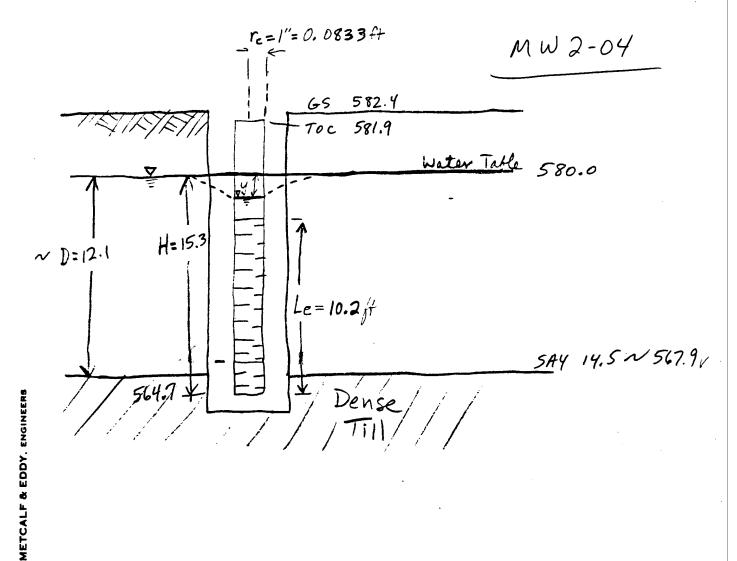
e) Using equation (5), $K = \frac{r_c^2 \ln R_e / r_w}{2L} (\frac{1}{t}) (\ln \frac{Y_o}{Y_t})$

$$K = \frac{(.0833 \text{ ft.})^2 (4.00)}{2(10.2 \text{ ft.})}$$
 (2.14 x 10⁻³ sec.⁻¹)

$$= 2.91 \times 10^{-6} \text{ ft./sec.}$$

$$= 8.9 \times 10^{-5} \text{ cm/sec.}$$





a) From semi-log plot (log Y_t vs t)

$$Y_0 = 1.82 \text{ ft.}$$
; at t = 12 sec., $Y_t = 1.69 \text{ ft.}$

so
$$\left(\frac{1}{t}\right)$$
 ln $\frac{Y_0}{Y_t} = \frac{1}{25}$ ln $\frac{1.77}{1.58} = 4.54 \times 10^{-3} \text{ sec.}^{-1}$

- b) $\frac{L_e}{r_w} = \frac{10.2 \text{ ft.}}{.0833 \text{ ft.}} = 122.4$
- c) From Figure 3, using $\frac{L}{r_w}$ = 122.4, C = 48
- d) For fully penetrating well, assume D = H and use equation (9)

$$\ln \frac{R_e}{R_w} = \left(\frac{1.1}{\ln (16.2/.0833)} + \frac{4.8}{10.2/.0833}\right)^{-1}$$

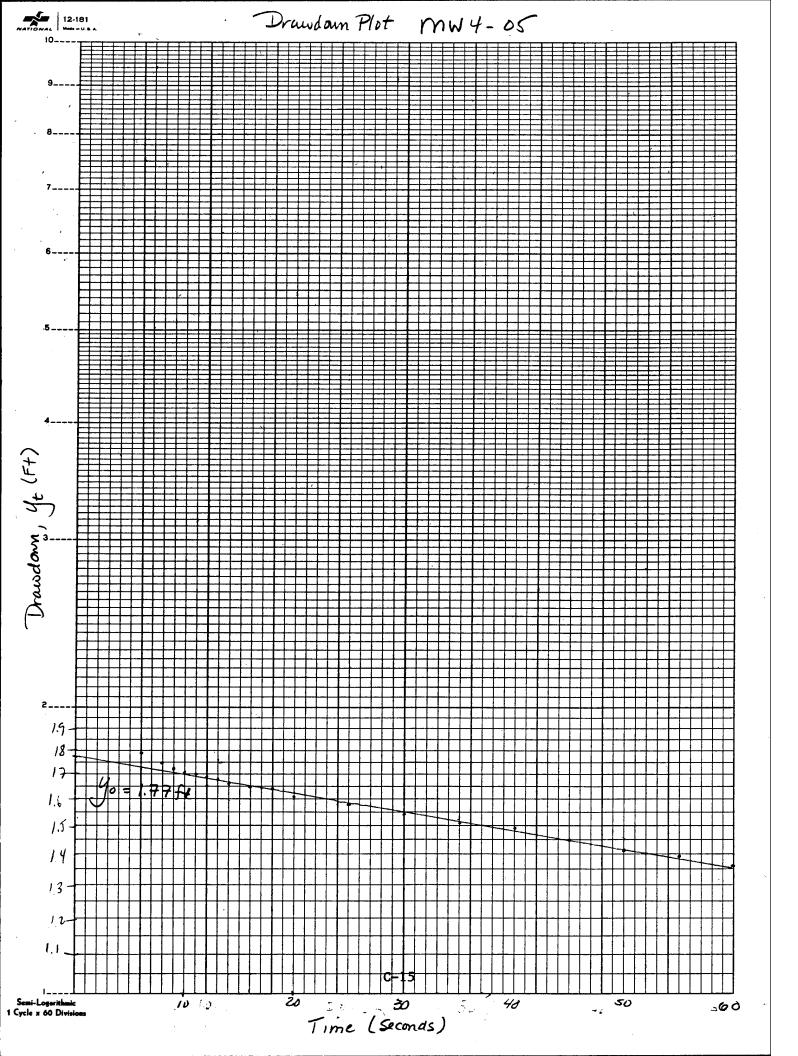
$$\ln \frac{R_e}{r_w} = 4.033$$

e) Using equation (5), $K = \frac{r_c^2}{2L} \frac{\ln (R_e/r_w)}{2L} (\frac{1}{t}) (\ln \frac{Y_o}{Y_t})$

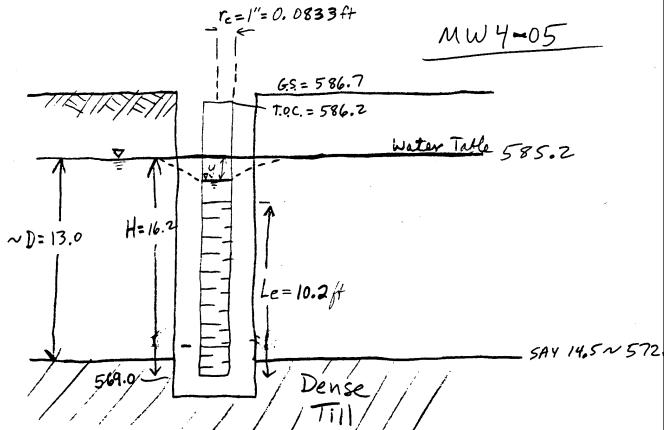
$$K = \frac{(.0833 \text{ ft.})^2 (4.033)}{2(10.2)}$$
 (4.54 x 10⁻³ sec.⁻¹)

$$K = 6.23 \times 10^{-6} \text{ ft./sec.}$$

$$K = 1.90 \times 10^{-4} \text{ cm/sec.}$$



METCALF & EDDY, ENGINEERS



a) From semi-log plot (log Y_t vs t),

$$Y_0 = 1.81$$
 ft. at t = 37.5 sec., $Y_t = 1.75$ ft.

so
$$\left(\frac{1}{t}\right) \left(\ln \frac{Y_o}{Y_t}\right) = \frac{1}{37.5} \ln \frac{1.81}{1.75} = 0.0008990 \text{ sec.}^{-1} = 8.99 \text{ x } 10^{-4} \text{ sec.}$$

b)
$$\frac{L_e}{r_u} = \frac{10.2 \text{ ft.}}{.0833 \text{ ft.}} = 122.4$$

- c) From Figure 3, using $\frac{L_e}{r_w}$ = 122.4, C = 4.8
- d) For fully penetrating well, assume D = H and use equation (9)

$$\ln \frac{R_e}{r_w} = \left(\frac{1.1}{\ln (12.5 \text{ ft./.0833 ft.})} + \frac{4.8}{10.2 \text{ ft./.0833 ft.}}\right)^{-1}$$

$$\ln \frac{R_e}{r_w} = (.2195 + .0392)^{-1} = (.02587)^{-1} = 3.865$$

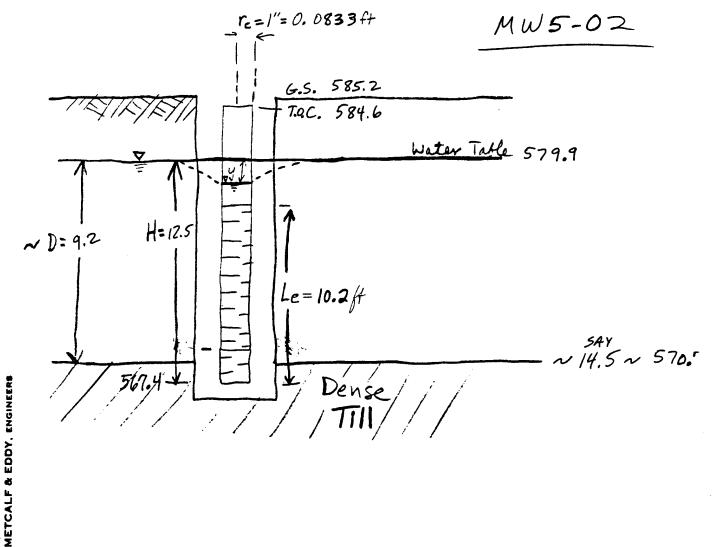
e) Using equation (5),
$$K = \frac{r_c^2 \ln (R_e/r_w)}{2L} (\frac{1}{t})$$
 (ln $\frac{Y_o}{Y_t}$)

$$K = \frac{(.0833 \text{ ft.})^2 (3.865)}{2(10.2 \text{ ft.})}$$
 (8.99 x 10⁻⁴ sec.⁻¹)

$$K = 1.18 \times 10^{-6} \text{ ft./sec.} = 3.61 \times 10^{-5} \text{ cm/sec.}$$

Well MW 5-02 SEMITOGRAPHIMIC 40 4050

NEUFEL & ESSER CO. Draw Koun, 4 (+1) 1,8 1.7 1.6 1.5 TIME (Sec) 40 60 50 20 0 10



- a) From semi-log plot (log Y_t vs t) get two slightly linear portions $Y_0 = 2.17$ ft.; at t = 12 sec., $Y_t = 1.80$ ft.
 - (i) $Y_0 = 1.60$ ft.; for t = 18 sec., $Y_t = 1.42$ ft.

$$\frac{1}{t}$$
 ln $\frac{Y_0}{Y_t}$ = $\frac{1}{18}$ ln $\frac{1.60}{1.42}$ = 6.63 x 10⁻³ sec.⁻¹

(ii) $Y_0 = 1.51$ ft., for t = 35 sec., $Y_t = 1.29$ ft.

$$\frac{1}{t}$$
 ln $\frac{Y_0}{Y_t}$ = $\frac{1}{35}$ ln $\frac{1.51}{1.29}$ = 4.45 x 10⁻³ sec.⁻¹

- b) $\frac{L_e}{r_w} = \frac{10.2 \text{ ft.}}{.0833 \text{ ft.}}$
- c) From Figure 3, using $\frac{L}{r_W}$ = 122.4, C = 4.8
- d) For fully penetrating well, assume D = H and use equation (9)

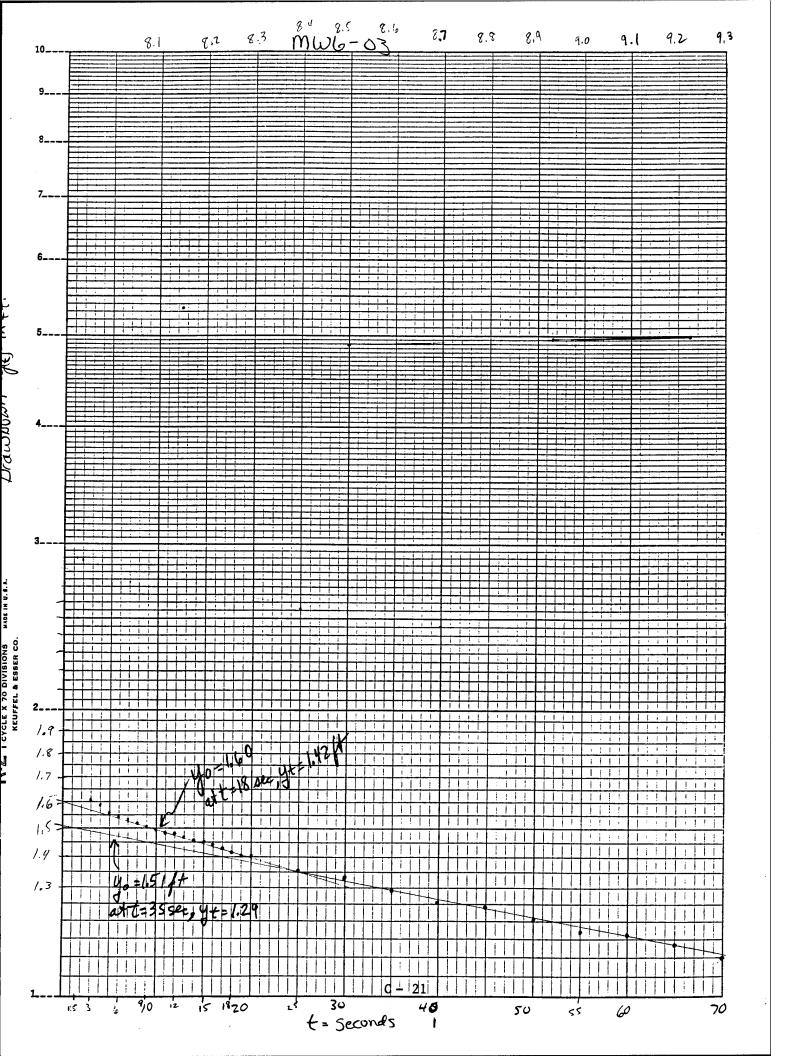
$$\ln \frac{R_e}{r_w} = \left(\frac{1.1}{\ln (13.0/.0833 \text{ ft.})} + \frac{4.8}{10.2 \text{ ft.}/.0833 \text{ ft.}}\right)^{-1} = .02570^{-1} = 3.89$$

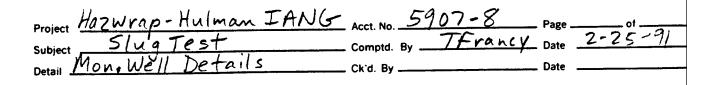
e) Using equation (5),
$$K = \frac{r_c^2 \ln \frac{R_e/r_w}{2L}}{2L}$$
 $(\frac{1}{t})$ $(\ln \frac{Y_o}{Y_t})$
(i) $K = \frac{(.0833 \text{ ft.})^2 (3.89)}{2(10.2 \text{ ft.})} = 6.63 \times 10^{-3} \text{ sec.}^{-1}$

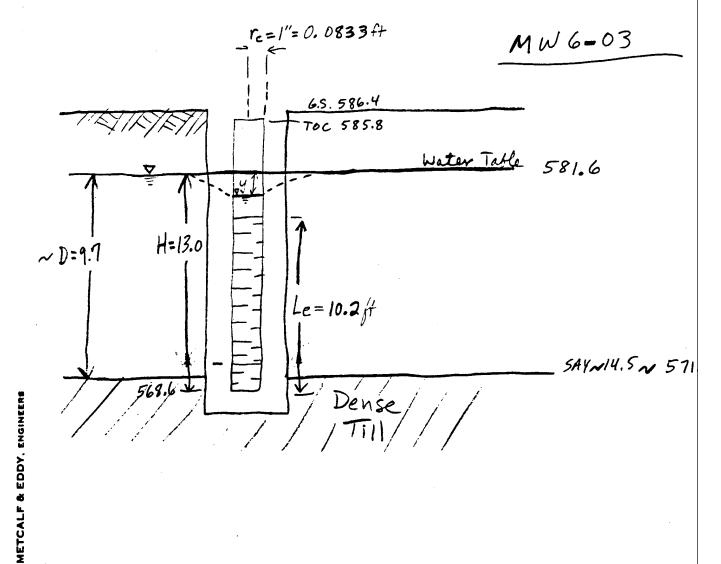
 $K = 8.7 \times 10^{-7}$ ft./sec. = 2.66 x 10^{-4} cm/sec.

(ii)
$$K = \frac{(0833 \text{ ft.})^2 \quad 3.89}{2(10.2 \text{ ft.})}$$
 (4.45 x 10⁻³ sec.⁻¹) = 5.96 x 10⁻⁶ ft. sec.
= 1.8 x 10⁻⁴ cm/sec.

average $K = 2 \times 10^{-4}$ cm/sec.







APPENDIX D Piezometer/Monitoring Well Development and Sampling Worksheets

Job Name	Hulman AN	Job :	No. 005907	Develo	pers <u>T.</u>	Aebie, R. Repinski
Well ID	P-1	Date Develope	d <u>9/30/</u>	<u>90 </u>	ime: Sta	rt <u>1310 h</u> End <u>1340 h</u> r
Casing Diameter Depth of well fro		inches $\div 12 = \frac{0}{\cdot}$ 9 \cdot 40 ft.	104 (d) ft. W		-	
Depth of water	from T.O.C.	3.90ft.	х	5	 	well volumes
Feet of standing			=	4.925		gallons to purge
Standing Water = π	. [(d) + 4] (h)		.48 gal/ft=_	.985	gals	PID Readings (ppm) Breathing 0.0 Well 0.0
Purging method	iBailer	Purge:	Time Start_	1310 hr		End <u>1340 hr</u>
1 well volume =	5.0	gal			ivity	Temperature, (C)
2 well volume =	6.0	gal	7.00	540		16,1
3 well volume =	11	gal	7.35	550	<u> </u>	15.7
						15.7
Sample Collection	on: Time Star	t	_ End		Bailer I	D#
	Sample	Characteristics	(Circle all a	pplicable)		
Describe odor:	none	sulfide	fishy	musty	petroleur	n
Describe color:	colorle	ss black	brown	orange	red	
Describe appeara	nce: turbid	silty sand c multiphased				
Organic Layer? _		Length?	Sa	amples pres	erved? _1	Final Sample
CommentsSu	rged with	bailer, dra	wdown obs	erved -	12 gal	lons bailed.
					<u>-</u>	

Job Name Hulman ANG	Job No. 00590	Developers _	J. Roderick, T.Franc
			tart 1230 hr End 1250 hr
Casing Diameter 1.25 inches Depth of well from T.O.C. 19.5	÷ 12 € <u>.104</u> (d)ft.	Well secured upon	
Depth of water from T.O.C. 5.3		х	
Feet of standing water14.2		=	gallons to purge
			PID Readings (ppm)
Standing 2 Water = $\pi [(d) + 4] (h)$			Breathing
Volume = $3.14 \left[\left(\frac{104}{104} \text{ ft} \right)^2 \div 4 \right]$	ft) x 7.48 gal/ft=	gals.	Well
Purging method bailer	Purge: Time Star	t 1230 hr	_ End1250 hr
	pН	Conductivity	
1 well volume =7.5			
2 well volume = 9.5			
3 well volume = 12	gal. 7.00	575	14
Final volume =			
Sample Collection: Time Start	End	Baile	r ID#
Sample Charact	eristics (Circle all	applicable)	
Describe odor: none	sulfide fishy	musty petrole	eum
Describe color: colorless	black brown	orange red	
Describe appearance: turbid silty	sand clay floate	rs sheen	
clear mult	phased foaming sli	my algae	
Organic Layer? Lengt	h?	Samples preserved?	
Comments			

Job Name _	Hulman A	ANG	Job	No.00590	7	Developers	3 <u>J.</u>	Roderick,	T. Aebie
Well ID _	P-3	Date I	Develope	d 9/30/	90	Time	e: Start	1300 hrEr	nd <u>1330 h</u> r
Casing Dian					Well Star	l secured up nding water (on arr (gal.) =	$\frac{0.843}{0.843}$	N
Depth of wa						5			es
Feet of stand					= _	4.215	9	gallons to p	urge
			todinadad kecaman	Lossessa addisa sees	2 i	ingenium kan erebidin sa na Ar	I	PID Readings	(ppm)
Standing Water =	$\pi I(d) + 4$	1 (ሴ)				-	E	Breathing	.0
Volume =	3.14 [(<u>* ¹⁰ ·</u>	$\frac{4}{1}$ (h) $\frac{4}{1}$ (t) +4] $\frac{1}{1}$	³ ⋅3ft) x 7	.48 gal/ft=	0.	.843 ga	als. V	Well	0.0
Purging met	hod	Bailer	_ Purge:	Time Star	rt	1300 hr	F	End <u>133</u>	0 hr
1 well volum	e =4.	5	_ gal	pH 6.55		Conductivity 550	y 	Temperatur	re, (C)
2 well volum	e =8.	5	gal	6.43		525		16.3	
3 well volum	e = <u>10</u>		_ gal	7.01		570		15.4	
Final volum	e = <u>12</u>		_ gal	7.05		560		15.1	
Sample Colle	ection: Time	e Start		_ End _	<u>.</u>	Ba	ailer ID)#	
	San	nple Charac	teristics	(Circle all	app	licable)			
Describe odor	n	one	sulfide	fishy	mu	ısty pet	troleum		
Describe color	: с	oloriess	black	brown) (orange re	d		
Describe appe	arance: (tı	urbid) (silty	sand o	lay floate	ers	sheen			
••	_			foaming s		algae			
Organic Layer	?	Leng	th?		Sam	ples preserv	red? <u>F</u>	inal Volu	ıme
Comments _	Drawd	own obser	ved, 12	2 gallon	s b	ailed.			
_									Minteres

Job Name	Hulman ANG	Job No	<u>005907</u> De	velopers <u>J.</u>	Roderick, T. Aebie
Well ID	P-4 Date	Developed 9/	30/90	Time: Sta	rt <u>1355 hr</u> End <u>1435 h</u>
Casing Diamete	er <u>1.25</u> inches om T.O.C. <u>15.75</u>	$\div 12 = 0.104(d)$ ft. silted)ft. Well sec	cured upon ar g water (gal.)	rival?
Depth of water Feet of standin	from T.O.C. <u>6.95</u> g water <u>8.80</u>	ft.	х	5	well volumes gallons to purge PID Readings (ppm)
Standing Water = π Volume = 3.1	$[(d)^{2} + 4] (h)$ $4[(\frac{\cdot 104}{6} tt^{2} + 4] (\frac{8}{6})$	· ^{8 (} t) x 7.48 gz	.i/ft=0.55	8 gals.	Breathing 0.0 ppm Well 0.0
Purging method	i	_ Purge: Time	Start		End
l well volume =	4	pH gal7.00		ductivity 10	Temperature, (C)
	7			90	16.5
3 well volume =	8	$_{-}$ gal. $\frac{7.01}{}$		90	
Final volume =	11.5	gai		90	16.0
	on: Time Start				D#
	Sample Charac	teristics (Circle	e all applical	ble)	
Describe odor:	none	sulfide fish	y musty	petroleur	m
Describe color:	colorless	black br	own orang	ge red	
Describe appeara		sand clay f			
	clear mul	iphased foamin	g slimy alg	ae	
Organic Layer?	Leng	th?	Samples	preserved?_	Final Volume
Comments 11	.5 gallons bail	ed, recover	ed peizom	eter to 15	.95 feet.

Job Name _	Hulman	ANG	Job N	No. 005907	Develop	oers	J.L.	T. Aebie
Well ID	P - 5	Date D	eveloped	10/9/9	<u>0</u> т	ime: Sta	art <u>1140</u>	hr End 1250h;
Casing Diam Depth of well	eter <u>1.2</u>	5_ inches ÷	- 12 =0 <u>.1</u>	<u>04</u> (d)ft. W	ell secured	upon a	rrival?	
Depth of wat	er from T.O.	C. 1.45	ft.	Х	<u> </u>		_ well '	volumes
Feet of stand	ing water _	18.05	(h) ft.	=			_ gallon	s to purge
Standing Water = Volume = 3	π[(d ² + 4] 3.14 [@ <u>. 104</u>	(h) t ² +4] <u>(</u> 18	3_ ft) x 7.	3 48 gal/ft=_		gals.	Breathi	adings (ppm)
Purging meth	odBai	ler	Purge: 1	Time Start_	1150h	<u>r</u>	End_	1225hr
1 well volume				pН	Conduct	ivity		erature, (C)
2 well volume								
3 well volume								
Final volume			-				15	
Sample Colle		Start				Bailer	ID#	
Describe odor:	nor	ie s	sulfide	fishy	musty	petroleu	m	
Describe color:	col	orless l	olack	brown	orange	red		
Describe appea	rance: (tur			ay floaters			د .	
Organic Layer:	?	Lengt	h?	Sa	amples pres	erved? _		
Comments								

Job Name	Hulman ANG	Job No. <u>005</u>	Developers <u>B</u>	. Repinski. T. Aebie
Well ID	P-6 Dat	te Developed9/3	0/90 Time: St	tart <u>1400hr</u> End <u>1445</u> hr
•		es $\div 12 = 0.104$ (d)ft 80 ft.	 Well secured upon Standing water (gal 	arrival? Y N .) = <u>1.05</u>
-	from T.O.C3_		x <u>5</u>	well volumes
-	ng water16.		= 5.25	_ gallons to purge
				PID Readings (ppm)
Standing Water =	$\pi [(d) + 4] (h)$			Breathing 0.0
Volume = 3.	$[(\frac{\cdot 104}{10}] \text{ ft}]^2 + 4]$	$(\frac{16.5}{6}) \times 7.48 \text{ gal/f}$	3 t= <u>1,05</u> gals.	Well
Purging metho	odBailer	Purge: Time St	art 1400 hr	_ End
1 well volume	_ 5	pH gal 6.98	Conductivity 820	Temperature, (C)
			790	
			780	
3 well volume :	9.0	gal 7.00	800	17.0
			Baile	
		acteristics (Circle a		
Describe odor:	none	sulfide fishy		
Describe color:	colorless	black brow	n orange red	
Describe appear	ance: turbid silt	y sand clay floa	iters sheen	
		nultiphased foaming	slimy algae	
Organic Layer?	Le	ngth?	_ Samples preserved?	Final Volume
Comments			low recharge, am t bailing peizom	
	dae co stow			

Job Name	Hulman ANG	Job	No. 005907	Developers	J. Roderick
Well ID	P-7	Date Develope	ed 10/1/90	Time: S	tart End 0 920 hr
Casing Dia Depth of we	meter <u>1.25</u>	inches $\div 12 = 0$ 19.30 ft. s	.10 (d)ft. We	ell secured upon anding water (ga	arrival? (Y/N) 1.) = (1.04) well volumes
		. 35 (h) ft.			gallons to purge
Standing Water	$= \pi [(d^2 + 4)]$				PID Readings (ppm) Breathing0.0
Purging me	ethodBa	iler Purge:	Time Start_	0845 hr.	End <u>0920 hr</u>
		gal	рН	Conductivity 625	
					15.2
3 well volu	me = 9.0 ne = 10.5	gal gal	6.61 6.68	710	15.3 15.2
				Baile	er ID#
	Sample	e Characteristics	(Circle all ap	plicable)	
Describe odo	or: none	sulfide	fishy n	nusty petrol	eum
Describe colo	or: color	less black	brown	orange red	4
Describe app	earance: turbi		clay floaters foaming slimy	sheen algae	
Organic Lay	er?	Length?	Sai	mples preserved	? Final Volume
Comments	Bailed	10.5 gallons,	, no notice	eable water 1	evel drop.

Job Name	Hulman ANO	Job	No. 005907	Develop	ers \underline{B} .	Reninski	
						0850 hrEnd 0925	hr
Casing Diam	eter 1.25	inches $\div 12 = \frac{0}{19.77}$ ft.	· 104(d)ft. W		upon arri	ival? Y N	
		. <u>4.20</u> ft.				well volumes	
Depth of stand	ing water	15.57 (h) ft.	=	4.95	{	gallons to purge	
reet of stand	illig water				I	PID Readings (ppm)	
Standing	$\pi[(d)^2 + 4]$			-	E	Breathing 0.0	
Water = Volume = 5	π [(a) + 4] (l 3.14 [(<u>····</u> ft)	$[+4] \frac{(15.57)}{(15.57)}$	3 7.48 gal/ft=_	0.989	gals. V	Vell 0.0	
		r Purge:				End <u>0925 hr</u>	
		gal	На	Conductiv		Temperature, (C)	
		gal				14.9	
2 well volume	e = <u>7.0</u>	gal	6.30	425			
3 well volume	e = <u> </u>	gal gal	6.19	440		14.6	
	ction: Time St	arte Characteristics	End		Bailer ID)# <u> </u>	
Describe odor:	none	sulfide	fishy	musty	petroleum		
Describe color:	colo	rless black	brown	orange	red		
Describe appea	arance: turbl	d silty sand multiphased					
Organic Layer	?	Length?	S	samples prese	erved?		
Comments							

Job Name Hull	lman ANG	Job N	lo. 005907	Developers	T. Aebie
Well ID MWB-0	Date	Developed	10/24/9	OTime	: Start 0900 hr End 0925 hr
Casing Diameter Depth of well from					on arrival? (3) N (3) = (3) 2.78
Depth of water from			х	5	well volumes
Feet of standing			=	13.9	gallons to purge
Standing Water = π [(Volume = 3.14	$(d^2 + 4]$ (h)		3 48 gal/ft=	2.78 ga	PID Readings (ppm) Breathing 0.0 Well 0.0
Purging method_	B-K pump	Purge: [Time Start_(9900hr	End0025 hr
l well volume = _				Conductivity 550	Temperature, (C)
2 well volume = _	9 gal	gal6	.68	575	15.3
3 well volume = _ Final volume = _	12 gal 16 gal	gal ⁷	.3	580 575	15.1 15.2
					ailer ID#
	Sample Chara	cteristics (Circle all ap	oplicable)	
Describe odor:	none	sulfide	fishy 1	nusty pet	roleum
Describe color:	colorless	black	brown	orange rec	<u> </u>
Describe appearanc	e: turbid silty	Sand cl	ay floaters	sheen	
	clear mu	ıltiphased f	oaming slimy	y algae	
Organic Layer?	Len	gth?	Sa	mples preserv	ed?
Comments	Purged 16 ga	allons, r	ecovery g	good.	

Job Name _	Hulman .	ANG Job N	No. 005907	Developers	T. Aebie
Well ID _					art 1210 h End 1300 h
Casing Diar	neter2	inches $\div 12 = \frac{.1}{19.0}$ ft.	⁶⁷ (d)ft. Wel		arrival? YN
	ter from T.O.C.		x	5	_ well volumes
	ding water		= .	13.1	_ gallons to purge
Standing Water	$= \pi [(d) + 4] (h)$		3 48 gal/ft= <u>2</u>	.62 gals.	PID Readings (ppm) Breathing 0.0 Well 3.0
Purging met	thod B-K	Purge: '	Time Start <u> 1</u>	210 hr	_ End1255 hr
		gal	рН	Conductivity	Temperature, (C)
					16.5
2 well volum	9	gal	7.21	510	16.3
Final volum	ne =13	gal	7.22	500	16.3
		rt <u>1255 hr</u>			ID#
	Sample	Characteristics (Circle all app	olicable)	
Describe odor	none) sulfide		usty petrole	um
Describe color	r: colorl	ess black	brown	orange red	
Describe appe	earance: turbid	silty sand cl multiphased f			
Organic Laye	r?	_ Length?	Sam	nples preserved?	
Comments _	Slow r	ecovery, purg	e slow to	keep from ba	iling dry.
-					
_					

Job Name .	Hulman ANG	Job No	.005907	DevelopersT	. Aebie
Well ID					art <u>1130 E</u> nd <u>1200 h</u> r
Casing Dia	meter <u>2</u>	inches + 12 = <u>. 167</u> 19.65 ft.	(d)ft. Well	l secured upon a	rrival? (Y)N
	ater from T.O.C.				_ well volumes
	nding water		= .	141	gallons to purge
Standing			3 8 gal/ft=	2.82 gals.	PID Readings (ppm) Breathing 0.0 Well 3.0
Purging me	ethod B-K Pu	mp Purge: T	ime Start	1130 hr	End1155hr
			pН	Conductivity	Temperature, (C)
		gal			18.0
		gal			17.4
3 well volu	me =9	gal	7.37	540	17.1
Final volur	$me = \frac{13}{14}$	gal	7.31	520	17.3
Sample Col		rt 1150 hr Characteristics (C			ID#
Describe odo	or: none	sulfide	fishy mu	usty petrole	ım
Describe colo	or: colorl	es s black	brown	orange red	
Describe app	pearance: turbid) silty sand cla multiphased fo			
Organic Lay	er?	Length?	Sam	iples preserved?	
Comments					

Job Name Hulm	an ANG	Job No. 00	5907 Develo	pers T. Ae	bie
Well ID MW4-0	5 Date	Developed 10	/24/90	Γime: Start_ ¹³	310 hEnd 1405 hr
Casing Diameter	² inches	$\div 12 = \frac{.167}{.167}$ (d)	t. Well secure	d upon arrival	? ∑ N
Depth of water from			x5	wel	l volumes
Feet of standing wa			= 14.4	gallo	ons to purge
Standing Water = π [(d Volume = 3.14 [(2) + 4] (h)		3 /ft=2.88	Brea	Readings (ppm) thing 0 2.0
Purging method	В-К	_ Purge: Time S	tart 1315 h	r End	1405 hr
1 well volume =		nН	Conduc	tivity Ten	nperature, (C)
2 well volume =	6	gal6.9	9 650		7.1
3 well volume =	9	_ gal6.6	0 620	1	7.6
Final volume =	13	gal7.2	625	1	7.0
Sample Collection:	$\frac{14}{\text{Time Start}}$	6.9 400 hr End	0 640 1405hr	Bailer ID# _	7.1
•		teristics (Circle			
Describe odor:	none	sulfide fishy	musty	petroleum	
Describe color:	colorless	black bro	wn orange	red	
Describe appearance:		sand clay flo			
Organic Layer?	Leng	th?	Samples pre	served?	
Comments <u>S1</u>	ow recovery,	purged slow	, cleaned r	ight up.	

Job Name	Hulman ANG	Job l	No 0 <u>05907-</u>	Developer	S <u>T. A</u>	ebie	
Well ID _	MW5-02 Da	te Develope	d <u>10/24/</u>	90 Tim	e: Start <u>9</u>	50hr En	1015 hr
Casing Diar	neter <u>2"</u> inch	es $\div 12 = \frac{16}{2}$	67 (d)ft. W	Vell secured up	on arriva	al? (Y/N	
Depth of we	ll from T.O.C19	• 7 ft.		standing water			
Depth of wa	ter from T.O.C5	<u>. 1</u> ft.	2	x 5			
Feet of stan	ding water <u> </u>	. 6 (h) ft.	=	12	ga	llons to pu	rge
Ctonding					65/00/18	Readings (
Water Volume =	= $\pi [(d)^2 + 4]$ (h) 3.14 $[(\frac{167}{2}$ ft) + 4]	<u>(14.6</u> ft) x 7	.48 gal/ft=_	<u>2.40</u> g	Bre gals We	eathing 0	. 5
Purging me	thodB-K_pump	Purge:	Time Start	0950 hr	En	d 1015	hr
1 well volun	ne = <u>3 gal</u>	gal.	pH 6.64	Conductivit	ty To	emperature	` -
	ne = <u>6 gal</u>			550		17.9	
	ne =9 ga1			550		18.0	
	$ne = \frac{12 \text{ gal}}{}$			550		17.6	
	ection: Time Start			015 hr E	Bailer ID#		
	Sample Cha	racteristics	(Circle all a	applicable)			
Describe odo	r: none	sulfide	fishy	musty pe	etroleum		
Describe colo	r: colorless	black	brown	orange re	ed		
Describe appe	earance: turbid si	ittle lty sand o	lay floater	s sheen			
	clear	multiphased	foaming slin	ny algae			
Organic Laye	er? L	ength?	S	amples preser	ved?		
Comments _	Good recovery	•					
_							
-			· · · · · · · · · · · · · · · · · · ·				
-							

Job Name _	Hulman ANG	Job	No. <u>005907</u>	Develop	ers T.	Aebie
Well ID	MW6-03	_ Date Develope	ed 10/24	/90Ti	me: Star	t 1035 hr End 1100 h
Depth of wat	er from T.O.C.	inches $\div 12 = .1$ 19.8 ft. 5.4 ft. 14.4 (h) ft.	2	K		well volumes gallons to purge
Standing	~ (d ² : 4) (b)		3 .48 gal/ft=_	2.36		PID Readings (ppm) Breathing 0.0 Well 0.1
Purging met	hod <u>B-K P</u> ı	ımp Purge:	Time Start	1040 hr		End1100hr
		gal	pН	Conducti	vity	Temperature, (C)
2 well volum	e =8	gal	6.3	620		16.8
						16.7
Final volum	e = <u>14</u>	gal	6.3	610		16.6
	Sample	rt 1055 hr	(Circle all a			O#
Describe odor:		sulfide	_			
Describe color	colorl	ess black	brown	orange	red	
Describe appe	arance: turbid	silty sand of multiphased				
Organic Layer	?	Length?	S	amples pres	erved?	
Comments _	Slow re	ecovery, purg	ged 14 ga	llons bef	ore sam	nple.
- - -						

Job Name Hulman	Joh	No. 005907	Samplers <u>KW/I</u>	LS
				art <u>1400 hr</u> End <u>1650 hr</u>
Casing Diameter top of s Depth of well from T. top of s Depth of water from	inches ÷ 12 =	.16 (d)ft. Wel Sta x	ll secured upon anding water (gal.)	rrival? (<u>Y</u> / X) =2.52 _ well volumes
	er <u>16.78</u> (h) ft.			
Water = π [(α) Volume = 3.14 [(+ 4] (n) 16_ft) + 4] (16.78ft) x	7.48 gal/ft=	2.52 gals.	Well 0
Purging method	pailer Purge	: Time Start	1520 hr	End1550 hr
1 well volume =	2.52 gal.		•	Temperature, (C) 56°F
2 well volume =	5.0 gal.	6.80	500	57°F
3 well volume =	7.5 gal.	6.82	550	58°F
	gal			56°F
	me Start 1550 hr Sample Characteristics			ID#
Describe odor:	(<u>none</u>) sulfide	fishy m	usty petroleu	m
Describe color:	colorless black	(lt. brown)	orange red	
Describe appearance:	(<u>turbid</u>) silty sand clear multiphased			
Organic Layer?No	Length? N	/A Sam	ples preserved? _	Yes
Comments				

Job Name	Hulman	Job No	Samplers	LS KW
				Start ⁰⁸¹⁵ hr End 0920 hr
Casing Dia	meter	inches ÷ 12 = <u>.16</u> (d	d)ft. Well secured upon h) Standing water (g	n arrival? <u>(Y</u> / X X
Depth of wa	ater from T.O.C.	3.34 ft. (12.74) x <u>3</u>	well volumes
			= 8.3	
arcanalisticanasasisticanas				KNX Readings (ppm)
Standing Water	$= \pi [(d)^2 + 4] (h)$			Breathing 0
			al/ft=gal	. Well <u>0</u>
Purging me	thod <u>bailer</u>	Purge: Time	Start 0840 hr	End0900 hr
		pł gal5	H Conductivity	Temperature,x(X) (F) 57°F
		gal. 6		58°F
		gal6		58°F
Final volum	ne =	gal7	.02 600	59°F
			<u>0920 hr</u> Bai	ler ID#
	Sample	Characteristics (Circl	le all applicable)	
Describe odo	1st 2	bailers	ny (mild musty) petro	oleum
Describe colo	or: (<u>colorie</u>	black (bl	orange roa	
Describe app	earance: (turbid) (<u>silty</u>) sand clay	floaters sheen	
	clear	multiphased foamir	ng slimy algae	
No hea	dspace reading	on first bailer		
Organic Laye	er? no	Length?	Samples preserved	1?
Comments	top 2 bailers	s - clear		
<u>-</u>				
-				
-				
_				

Job Name	Hulman ANG	Job l	No. 005907	_ Samplers _ L	Spence & K. Walter
Well ID	MW2-04	_ Date Sample	11/9/90	Time: S	tart 1715 hr End 1830 hr
•	neter <u>2</u> ill from T.O.C		Sta	nding water (gal	.) = 2.8
Depth of wa	ter from T.O.C.	2.60 ft.			well volumes
Feet of stan	ding water $\frac{16}{}$.91 (h) ft.	=	8.3	gallons to purge OVA
Standing					XXX Readings (ppm)
Water	$= \pi [(d^2 + 4] (h)$		9		Breathing25 ppm
Volume =	3.14 [(ft) ² ·	+4] <u>ft</u> ft) x 7.	48 gal/ft=	gals.	Well 2 ppm
Purging me	thod <u>bailer</u>	Purge:	Time Start	1720 hr	End1805 hr
1 well volun	ne =3_	gal.	pH 7 . 30	Conductivity 600	Temperature,XXX) (F) 61°F
	ne =6			575	60°F
		gal		600	59°F
	ne =			575	59°F
Sample Coll	ection: Time Star Sample	t <u>1810 hr</u> Characteristics (r ID#
Describe odor	: (<u>none</u>)	sulfide	fishy m	usty petrole	eum
Describe color	r: colorle	ss black	brown	orange red	grey
Describe appe	earance: (<u>turbid</u> clear				
Organic Laye	r? <u>no</u>	Length?	San	nples preserved?	
Comments _					
_					

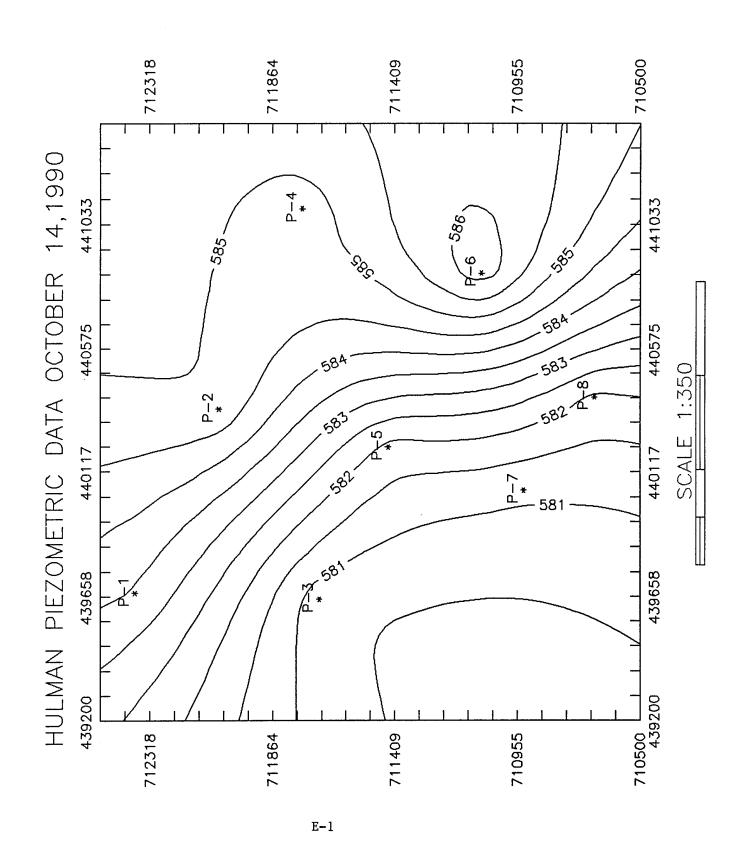
Job Name	HULMAN A	NG	Job	No. 005907	_ Samplers LS	KW
Well ID	MW4-05		Date Sampl	ed <u>11/11/90</u>	Time: St	tart <u>1000 hr</u> End <u>1055 hr</u>
					ell secured upon	
Depth of w	ell from T.	O.C. <u>19.7</u>	<u>1</u> ft.	St	anding water (gal	.) = <u>2.7</u>
-		T.O.C. <u>3.</u>			3	well volumes
Feet of sta	nding wate	er16	.41 (h) ft.	=	8.1	_ gallons to purge
Standing						PXX Readings (ppm)
Water	$= \pi [(d)]$	+4] (h)				Breathing5
Volume	= 3.14 [(${ft}^{2} + 4$	ft) x	7.48 gal/ft=	gals.	Well100
Purging me	ethod	bailer	Purge	: Time Start_	1025 hr	End 1050 hr
g g				На		
l well volu	me =	2.75	gal	7.13	_	60°F
2 well volu	me =	5.5	gal	6.60	700	60°F
3 well volu	me =	8.25	gal	6.82	650	61°F
Final volu	me =		gal	6.86	650	61°F
				End10!		: ID#
•						
	S	ample Char	acteristics	(Circle all ap	plicable)	
Describe odd	or:	(<u>none</u>)	sulfide	fishy n	nusty petrole	um
Describe colo	or:	colorless	black	(<u>lt.brown</u>)	orange red	
Describe ann	vearance.	turbid (silt	v) sand	clay floaters	sheen	
Describe app	,curunco.			foaming slimy		
		0. 0	• • • • • • • • • • • • • • • • • • •		J	
0 1	2 No	Ιο	nath?	Sai	nnlee preserved?	
Organic Lay	er? <u></u>	Le	ngtii:	Jai	inpies preserveu.	
Comments	No float	ing produc	t - heads	pace initial	bailer = 0	
				turned lt.		
	still fa	irly clear		-		

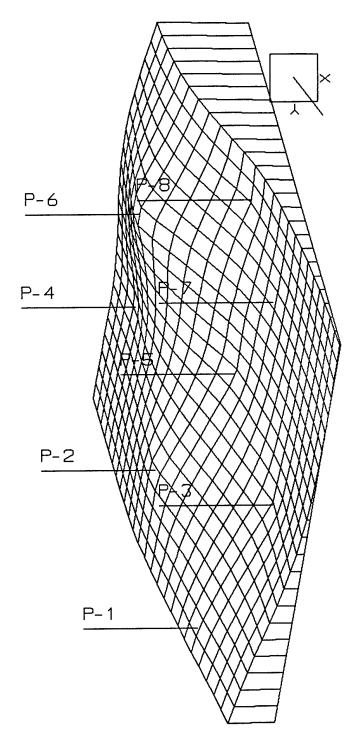
Job Name	Hulman		Job N	No. 005907	7 5	Samplers <u>L. S</u>	pence & K. Walter
Well ID	MW5-02	Dat	e Sampleo	i <u>11/11</u>	/90	Time: St	art 1230 hr End 1430 hr
Casing Dia	meter	2 inches	÷ 12 = 1/	<u>/6</u> (d)ft. v	Well s	secured upon a	arrival? (Y)M
Depth of w	ell from T.	O.C. <u>19.61</u>	ft.		Stand	ling water (gal.) =
Depth of w	ater from	Г.О.С. <u>5,12</u>	ft.		x _	3	_ well volumes
Feet of sta	nding wate	er <u>14.49</u>	_ (h) ft.	:	=	7.3	_ gallons to purge OVA
Standing	9						XXX Readings (ppm)
Standing Water	$= \pi[(d)'$	+4] (h)					Breathing 0 ppm
Volume	= 3.14 [(ft) +4] <u>(</u>	ft) x 7.	3 48 gal/ft=		gals.	Well 2 ppm
Purging me	ethod	bailer	_ Purge: '	Time Start	13	20 hr	End 1330 hr
		2.5					Temperature,XXX) (F)
2 well volu	me =	5.0	gal	6.32		725	64°F
						725	
Final volum	me =		gal	6.64		650	64°F
							ID#
	S	ample Charac	teristics (Circle all	applic	cable)	
Describe odo	or:	none	sulfide	fishy	must	y petrolei	ım
Describe colo	or:	colorless	black	(brown	ght ora	ange) red	**************************************
Describe app	earance: (slightly turbid silty	sand cl	av floatei	rs sl	heen	
Doocbe upp				oaming sli			
			.	3	•	ŭ	
Organic Laye	er?N	oLeng	th?		Sampl	es preserved?	des de la constante de la cons
Comments	Water no	ted between 1	the well	and the o	uter	casing to a	level
•					· · · · · · · · · · · · · · · · · · ·		
							V
_							

Job Name Hulman	Job No00	5907	SamplersK.	Walter L. Spence
Well ID MW6-03 Da	te Sampled $\frac{11}{}$	11/90	Time: Sta	art 1550 hr End 1650 hr
Casing Diameter 2 inches Depth of well from T.O.C. 19.65	$\div 12 = \underline{.16} (d) f$	t. Well	secured upon a	
Depth of water from T.O.C. (5.82			3	_ well volumes
Feet of standing water 13.83		= _	6.9	_ gallons to purge OVA P版 Readings (ppm)
Standing Water = $\pi [(d) + 4](h)$				Breathing 0
Volume = 3.14 [(ft) + 4] (ft) x 7.48 gal/	3 /ft=	gals.	Well0
Purging method <u>bailer</u>	Purge: Time S	tart	1555 hr	End 1615 hr
1 well volume =2.25	На	(Conductivity	Temperature, XXX) (F)
2 well volume =4.50	gal6.	60	800	63°F
3 well volume = 6.75				62°F
Final volume =	gal6.	53	750	62°F
Sample Collection: Time Start1				ID#
Sample Chara	cteristics (Circle	all appl	licable)	
Describe odor: none	sulfide fishy	mus	sty petroleu	ım
Describe color: colorless	black brow	wn o	range red	4-4
Describe appearance: turbid silty clear mu	sand clay flo			
Cicai Ind	itiphased founding	0	5	
Organic Layer? No Len	gth?	Samp	oles preserved?	
Comments				

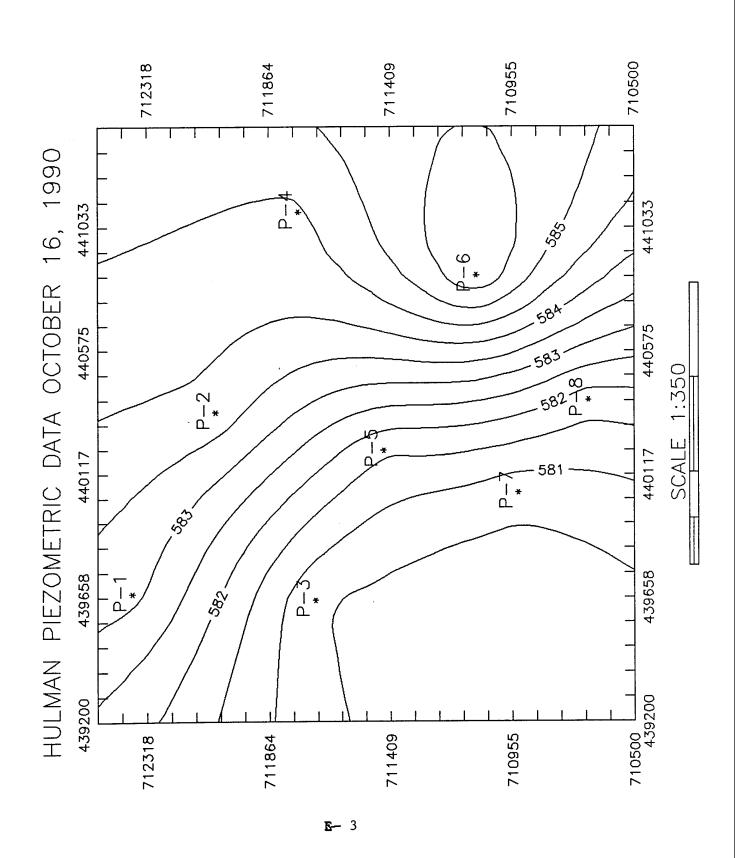
Job Name	Hulman	Job No.	005907	Samplers EJI	O MD
Well ID	MWA-08	Date Sampled _	11/9/90	Time: St	tart 1330 hr End 1550 hr
Casing Dia	ameter in	ches ÷ 12 =	(d)ft. Wel	l secured upon	arrival? Y/N
Depth of w	rell from T.O.C.	ft.	Sta	nding water (gal	.) =
Depth of w	vater from T.O.C	ft.	x		well volumes
Feet of sta	nding water	(h) ft.	= .		_ gallons to purge
Standing Water Volume	= $\pi [(d^2 + 4] (h)]$ = 3.14 $[(\underline{ft}^2 + 4]]$	I] <u>(</u> tt) x 7.48	gal/ft=	gals	PID Readings (ppm) Breathing Well
Purging me	ethod	Purge: Tim	ne Start		_ End
	me =	gal			
	me =	•			
		-			
Final volu	me =	gal6.8	3	650	59°F
Sample Co	llection: Time Start	Er	nd	Bailer	· ID#
	Sample Ch	naracteristics (Cir	cle all app	licable)	
Describe odd	or: none	sulfide fi	shy mu	ısty petrole	um
Describe colo	or: colorless	black	brown o	orange red	*******************************
Describe app	pearance: turbid clear	silty sand clay multiphased foan		sheen algae	
Organic Lay	er?	Length?	Sam	ples preserved?	
Comments	This is the	water supply wel			
	Well characs	forthcoming fro	om CE dept		

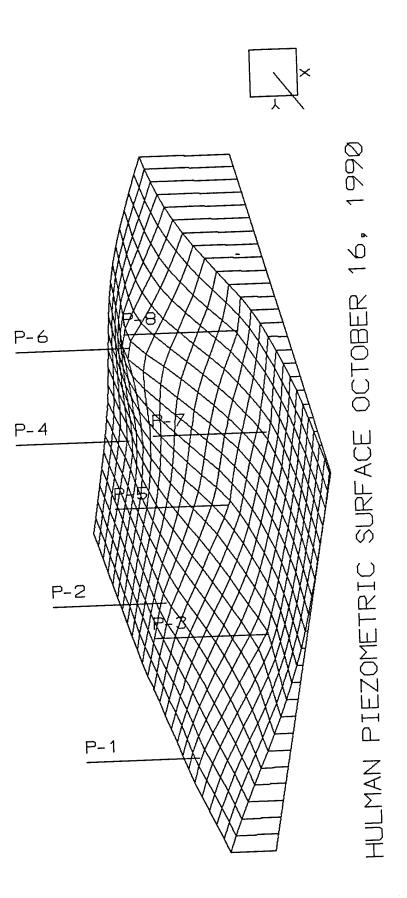
APPENDIX E Piezometric Surface and Till Contours

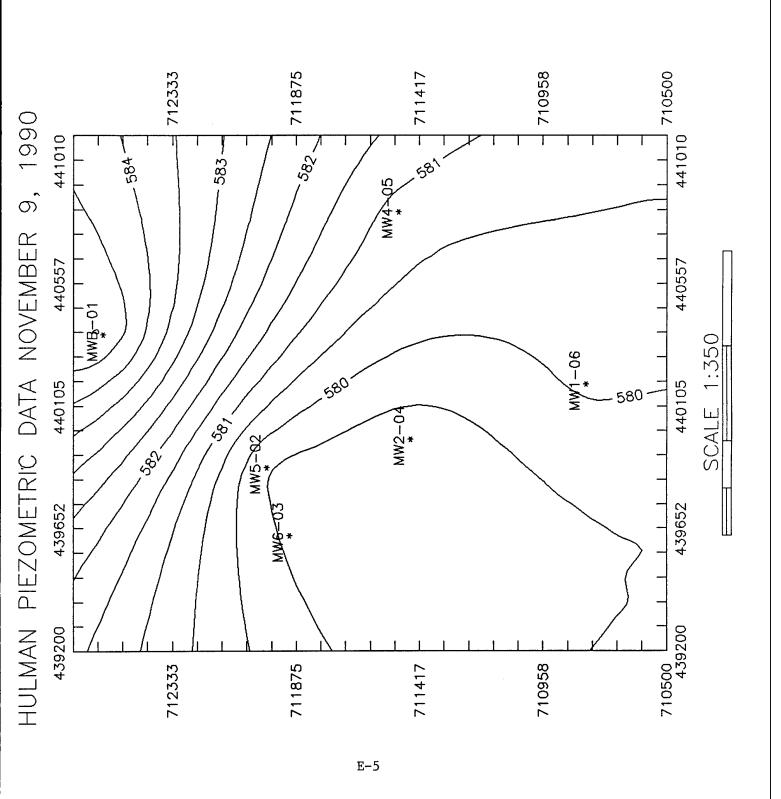


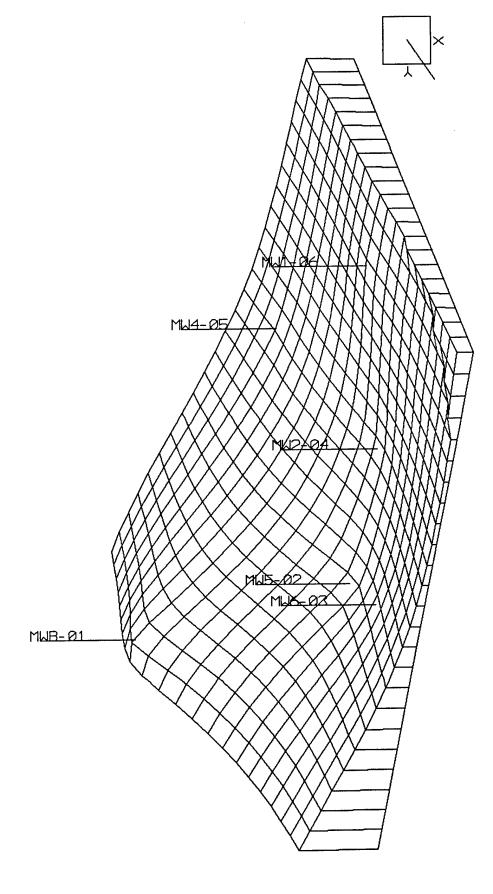


HULMAN PIEZOMETRIC SURFACE OCTOBER 14, 1992

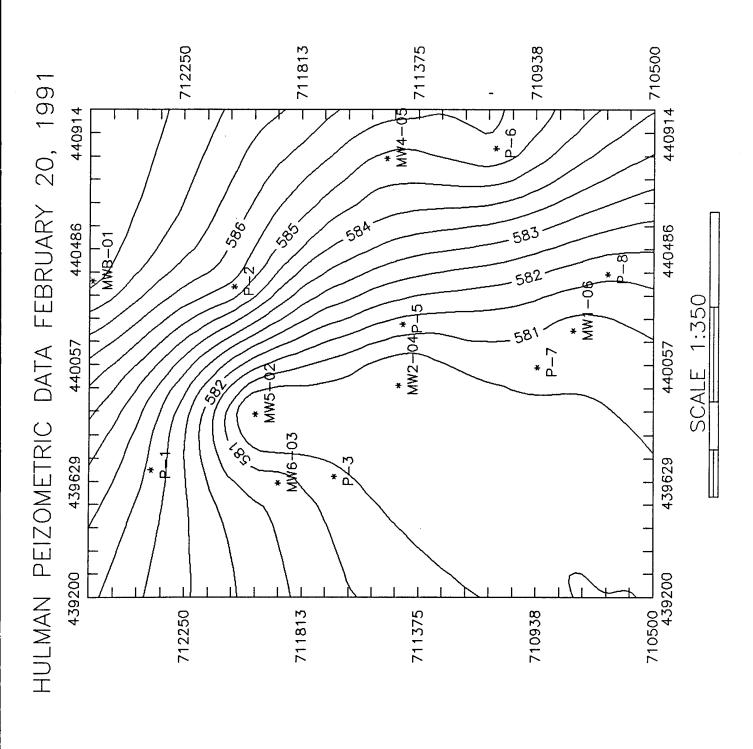




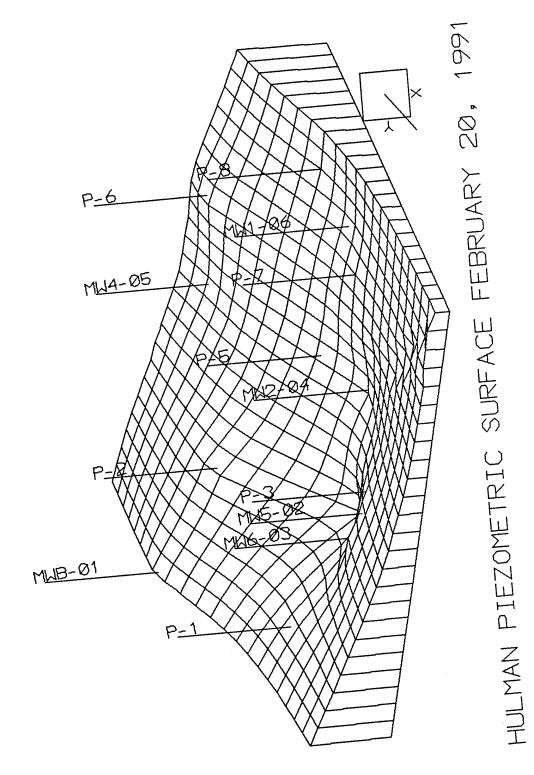


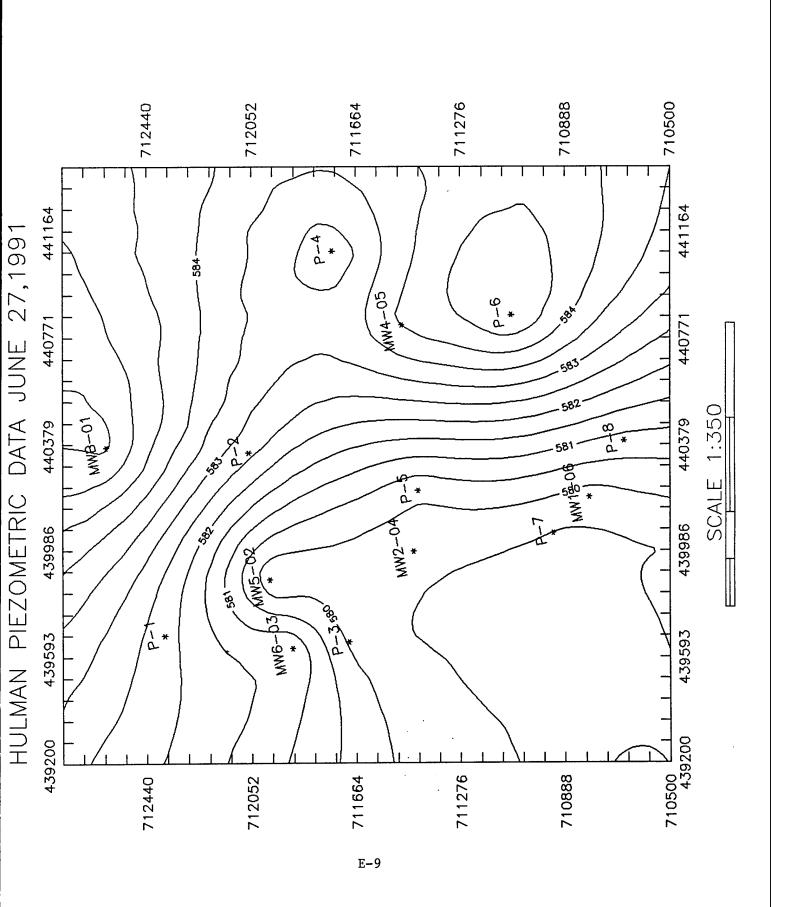


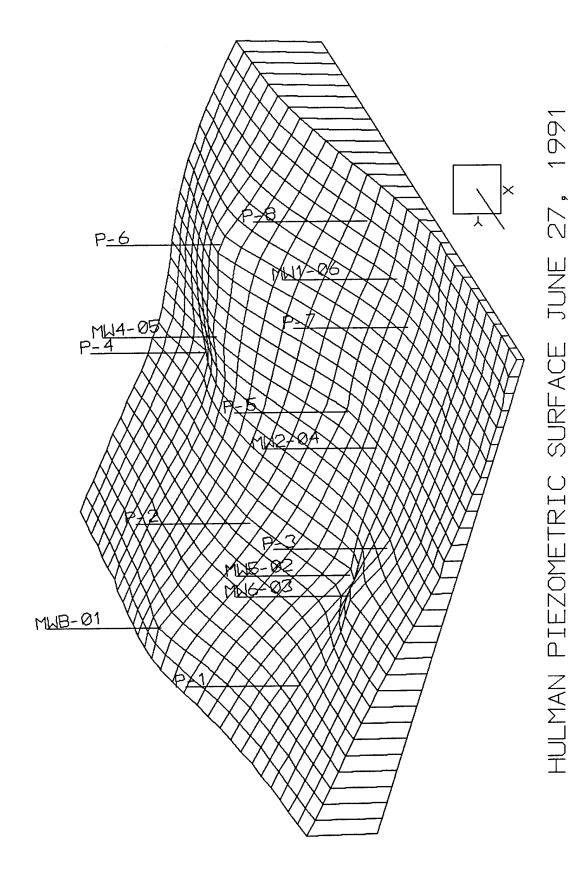
HULMAN PIEZOMETRIC SURFACE NOVEMBER 9,



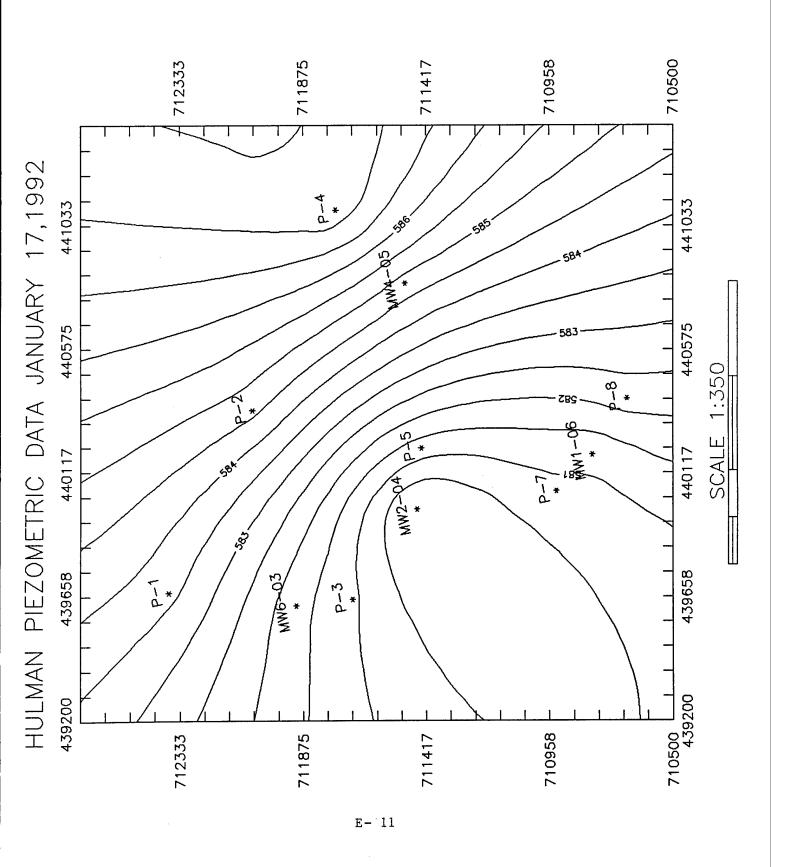
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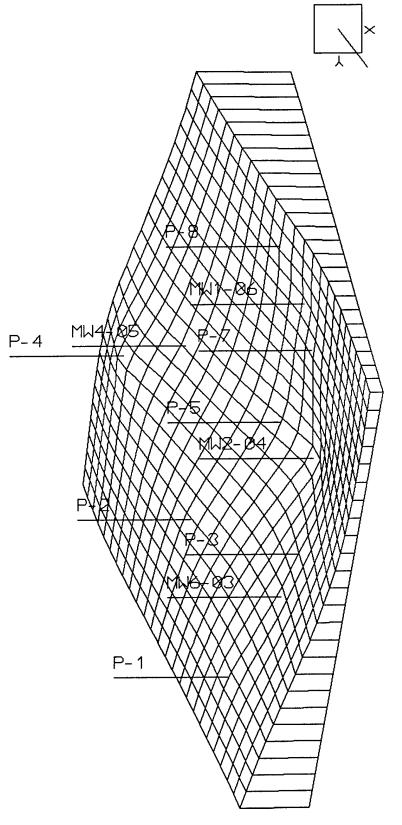






E-10

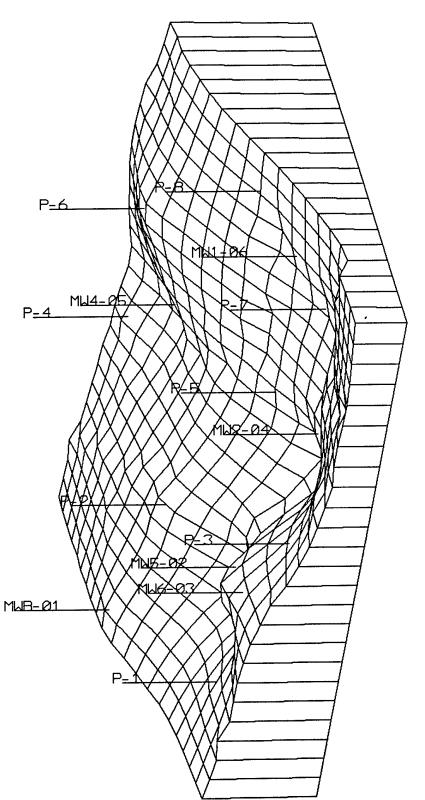




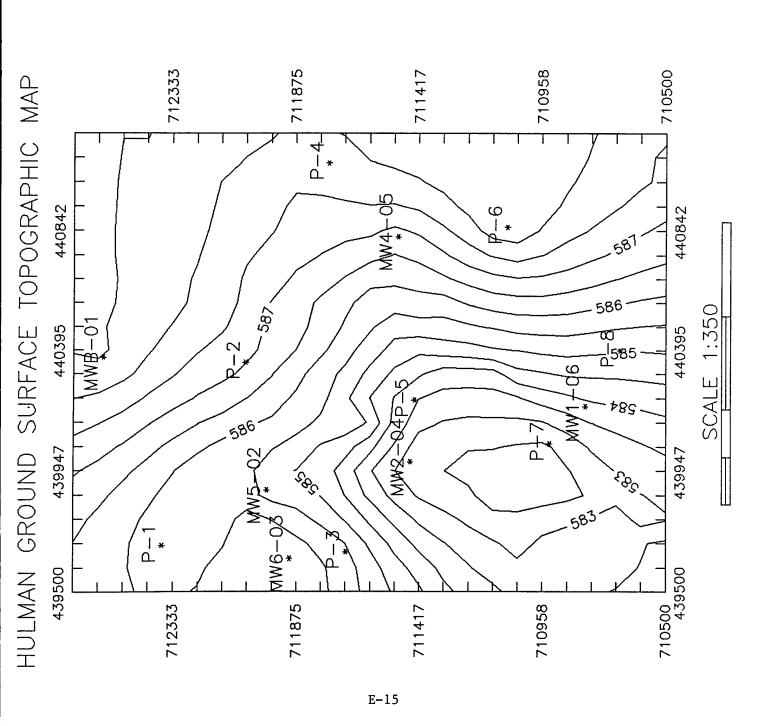
HULMAN PIEZOMETRIC SURFACE JANUARY 17, 1992

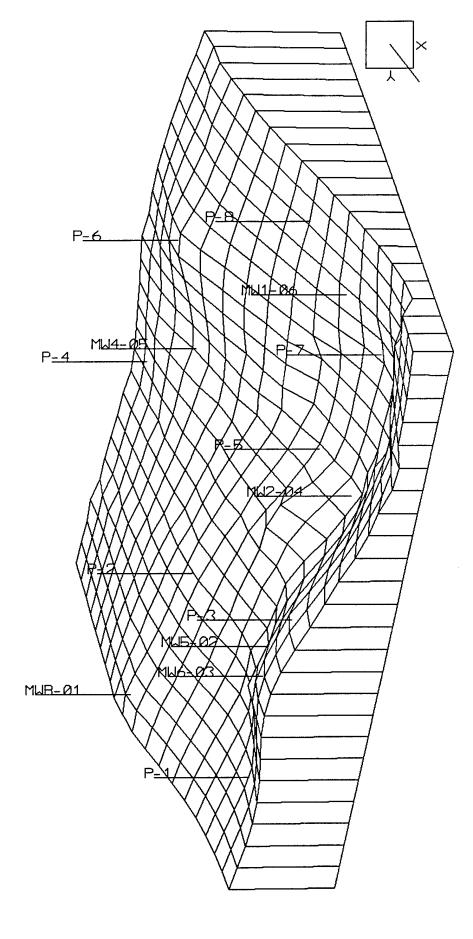
HULMAN: TOPOGRAPHIC MAP OF THE TILL SURFACE £13/ \$-6 1:350 MWB-01 d + 8√3 56⁹ S SCALE 69_Ş (61) 0 69 0 69 56⁸ Poli 571-710500 L 1-439400





HULMAN TILL SURFACE





HULMAN 3-DIMENSIONAL VIEW OF GROUND SURFACE

APPENDIX F Quality Control Data & Validation

QUALITY CONTROL / QUALITY ASSURANCE

The following is a summary of quality control samples collected at 181st Fighter Group, Indiana Air National Guard, Hulman Municipal Airport, Terre Haute, Indiana during both sampling rounds. Round one sampling took place from October 11, 1990 through November 10, 1990. Round two sampling took place from January 11, 1992 through January 18, 1992.

Trip Blanks

As per the Final Site Investigation Sampling and Analysis Plan, Hulman ANG, September, 1990, one trip blank was submitted to the laboratory for each batch of volatile organic samples collected per matrix. Although some samples are of the same matrix, different trip blanks were submitted because each is considered to be taken from a unique source. Trip blanks are collected to verify that the samples were not contaminated during transport.

	SAMPLE IDENTIFICATION	SHIPMENT DATE
ROUND ONE:	BH0 - 01 - T1 - 31	10-11-90
	SSO - 01 - T1 - 56	10-11 -9 0
	BHO - 02 - T2 - 32 - 0 - 0	10-12-90
	SSO - 02 - T2 - 57	10-12-90
	BHO - 03 - T3 - 33 - 0 - 0	10-13-90
	BHO - 05 - T5 - 35 - 0 - 0	10-15-90
	BHO - 04 - T4 - 34 - 0 - 0	10-15-90
	MW0 - 01 - T1 - 79 - 0 - 0	11-09-90
	SE0 - 01 - T1 - 98 - 0 - 0	11-10-90
	MW0 - 02 - T2 - 80 - 0 - 0	11-11-90
	MW0 - 03 - T3 - 90 - 0 - 0	11-11-90
ROUND TWO:	MW0 - 01 - T1 - 117	1-15-92
	MW0 - 02 - T2 - 118	1-16-92
	MW0 - 01 - T3 - 119	1-17-92
	MW0 - 01 - T4 - 120	1-18-92

Field Blanks

equipment.

As per the Final Site Investigation Sampling and Analysis Plan, Hulman ANG, September, 1990, field blanks were collected for each water type used during a specific sampling episode.

The two beginning characters of the sample identification indicate the types of samples being taken at the time. An example: BHO - 00 designates borehole sampling.

A field blank verifies the integrity of the water used for decontamination of sampling

	SAMPLE IDENTIFICATION	DATE SAMPLED	WATER TYPE
ROUND ONE:	BHO - 00 - F1 - 39	10-12-90	TAP WATER
	BHO - 00 - F2 - 40	10-12-90	DEIONIZED WATER
	BHO - 00 - F3 - 59	10-12-90	HYDRANT WATER
	MW0 - 01 - FD - 81 - 0 - 0	11-09-90	DEIONIZED WATER
	MW0 - 01 - FT - 82 - 0 - 0	11-09-90	TAP WATER
ROUND TWO:	MW0 - 01 - FD - 140	01-15-92	DEIONIZED WATER
	MW0 - 02 - FT - 141	01-15-92	TAP WATER

Equipment Blanks

As per the Final Site Investigation Sampling and Analysis Plan, Hulman ANG, September, 1990, equipment blanks were collected one per every other day of sampling. Equipment blanks verify effective decontamination procedures were used in the field.

	DATES SAMPLED	EQUIPMENT BLANKS COLLECTED
ROUND ONE:		
SURFACE SOILS	10-11-90	SSB - 01 - E1 - 58 - 0 - 0
	10-12-90	SS6 - 01 - E1 - 58 - 0 - 0
BORE HOLES	10-12-90	BH5 - 03 - E1 - 36 - 0 - 0
	10-14-90	BH4 - 12 - E2 - 37 - 0 - 0
	10-15-90	BH1 - 15 - E3 - 38 - 0 - 0
SEDIMENTS	11-10-90	SEB - 01 - E1 - 96 - 0 - 0
SURFACE WATERS	11-10-90	SWB - 01 - E1 - 99 - 0 - 0
MONITORING WELLS	11-09-90	MWB - 01 - E1 - 78 - 0 - 0
ROUND TWO:		
MONITORING WELLS	1-16-92	MWB - 01 - E1 - 133
		MW1 - 06 - E2 - 134
SURFACE SOILS	1-16-92	SS6 - 16 - E2 - 134

Field Duplicates

As per the Final Site Investigation Sampling and Analysis Plan, Hulman ANG, September, 1990, field duplicates were collected at a frequency of 1 per 10 samples. Field duplicates determine the variability between duplicate samples.

SAMPLE TYPE	# SAMPLES	DUPLICATE SAMPLE ID
ROUND ONE:		SS4 - 14 - NS - 54 - 0.0 - 0.5
SURFACE SOILS	17	SS4 - 15 - NS - 55 - 0.0 - 0.5
BORE HOLES	34	BH1 - 15 - NS - 30 - 4.0 - 6.0
		BH4 - 11 - NS - 22 - 4.0 - 6.0
		BH6 - 04 - NS - 07 - 2.0 - 4.0
SEDIMENTS	5	SE1 - 05 - NS - 95 - 0.0 - 0.0
SURFACE WATERS	3	SW1 - 05 - NS - 87 - 0.0 - 0.0
MONITORING WELLS	7	MW5 - 07 - NS - 76 - 0.0 - 0.0
ROUND TWO:		
SURFACE SOILS	5	SS6 - 21 - 116 - 0.0 - 0.5
MONITORING WELL/ PIEZOMETER	8	MW6 - 07 - NS - 107

Matrix Spike/Matrix Spike Duplicate

As per the Final Site Investigation Sampling and Analysis Plan, Hulman ANG, September, 1990, matrix spike / matrix spike duplicates were performed one per batch of twenty samples sent to the laboratory for analysis. The field team specified which samples were to be analyzed as matrix spike / matrix spike duplicate due to the need for extra sample volume. MS/MSDs are a recovery check on the actual sampling matrix.

SAMPLE TYPE	QUANTITY	MS/MSD SAMPLE
ROUND ONE:		
SURFACE SOILS	17	SS5 - 05 - NS - 45 - 0 - 0.5
BORE HOLES	34	BH1 - 14 - NS - 27 - 2 - 4 BH2 - 09 - NS - 17 - 2 - 4
SEDIMENTS	5	SE1 - 04 - NS - 94 - 0 - 0
SURFACE WATERS	3	SW1 - 04 - NS - 86 - 0 - 0
MONITORING WELLS	7	MW6 - 03 - NS - 72 - 0 - 0
ROUND TWO:		
SURFACE SOILS	5	SS6- 20- 115- NS - 05
MONITORING WELL/ PIEZOMETER	8	MW6 - 03 - NS - 103

DETECTED CONCENTRATIONS FOR QUALITY ASSURANCE SAMPLES (Round 1. November, 1990) HULMAN ANG

PARAMETER	METHOD UNITS	UNITS	REPTD DETECT LIMIT	LOCATION U - ID Depth, FT LAB ID #	BH0-01 11- 31 9010L110-003	BH0-02 172 - 32 0-0 9010L151-002	BH0-04 114 - 34 00 9010L186-022	BH0-05 T5 - 35 0-0 8010L188-010	BH1-15 E3 - 38 0-0 9010L186-005
VOLATILE ORGANICS									
Acetone	CLP	UG/L	9		æ	3	J 01	9	2
Carbon Disulfide	CLP	UG/L	\$		2	2 0	⊃ \$	20	مه ح
Chloroform	CLP	UG/L	r)		9 N	2 0	2	ک د	2 C
Bromodichloromethane	S.P	UG/L	S		⊃ s	2 C	⊃ •	2	⊃ s
Dibromochloromethane	먑	Na/L	40		၁	၁	2	2	
Bromoform	CLP	UG/L	S		2	⊃ \$	2	2	2
Toluene	급	UG/L	9		2 2	2	⊃ S	D	⊃ ••
METALS									
Calcium, Soluble	SW6010	Ng/L	200						
Calcium, Total	SW6010	UG/L	200						⊃ 200 200
Copper, Soluble	SW6010	UG/L	25						
Copper, Total	SW8010	UG/L	52						25 U
Iron, Total	SW6010	Ng/L	5						04
Magnesium, Soluble	SW6010	UG/L	2000						
Magnesium, Total	SW6010	UG/L	200						⊃ 200
Sodium, Soluble	SW6010	UG/L	2000						
Sodium, Total	SW6010	UG/L	2000						D 006

DETECTED CONCENTRATIONS FOR QUALITY ASSURANCE SAMPLES (Round 1. November, 1990) HULMAN ANG

DARAMETER	STINIT COHEST		BEFECT I	LOCATION U - ID Denth FT	BH4-12 E2 - 37 0-0	BH5-03 E1 - 36 0-0	BHO-00 F1 = 38	BHO-00 F2 - 40	BHO-00 F3 - 56
				LABID#	9010L166-021	9010L151-001	9010L151-017	9010L151-018	9010L151-019
VOI ATII E OBGANICS									
Acetone	S.	UG/L	9		16	30 67	23 UJ	22 UJ	20 CZ
Carbon Disulfide	CL _P	UG/L	2		10	2 0	2 C	2 C	D 6
Chloroform	CLP	UG/L	ις.		S	-	45	7	48
Bromodichloromethane	CLP	UG/L	9		2 C	2 8	88	D 9	37
Dibromochloromethane	CLP	UG/L	2		D 9	2 C	8	O 6	58
Bromoform	CLP CLP	UG/L	40		20	2 0	7	D 9	7
Toluene	CLP.	UG/L	49		5 U	⊃ \$	٠,	<u>ء</u> د	-
METALS									
Calcium, Soluble	SW6010	UG/L	8						
Calcium, Total	SW8010	UG/L	200		200 U	200 C	70800 J	500 ∩	70100 J
Copper, Soluble	SW6010	עפער	52						
Copper, Total	SW6010	UG/L	25		22 N	22 N	22 N	22 N	25 U
Iron, Total	SW6010	UG/L	100			40 U	50.4	5 5	335
Magnesium, Soluble	SW6010	UG/L	2000						
Magnesium, Total	SW6010	UG/L	2000		200 U	O 002	21700 J	200 O	21600 J
Sodium, Soluble	SW6010	UG/L	2000						
Sodium, Total	SW6010	UG/L	2000		D 006	n 006	66300 J	n 006	65700 J

DETECTED CONCENTRATIONS FOR QUALITY ASSURANCE SAMPLES (Round 1. November, 1990) HULMAN ANG

Depth, FT 00 LAB ID# 90010L162-005 10 U 50 U 50 U 50 U 50 U 50 U	Depth, FT	90111.672008	0.0-0.0 9011L572-001 12 UJ 5 U 5 U 5 U	9011[572-003 9011[572-003 13 UJ 5 U 5 U 5 U	0.0-0.0 B011L572-002 15 UJ 5 U 5 U
NICS CLP CLP CLP CLP CLP CLP CLP C	ryg D.≰	9011L572-008	9011LS72-001 12 UJ 5 U 10 5 U 5 U	901115672-3003 13 UJ 5 U 1 UJ 5 U	6011L572-002 15 UJ 5 U 51 51
NICS CLP UG/L CLP UG/L CLP UG/L CLP UG/L CLP UG/L CLP UG/L CLP UG/L SW6010 UG/L SW6			25 c 05 c c c c c c c c c c c c c c c c c		51 U. 5 U. 5 U.
CLP UG/L 10 CLP UG/L 5 CLP UG/L 5 CLP UG/L 5 CLP UG/L 5 CLP UG/L 5 CLP UG/L 5 CLP UG/L 5 CLP UG/L 5 CLP UG/L 5 CLP UG/L 5 CLP UG/L 5 CLP UG/L 5 CLP UG/L 5 SW6010 UG/L 500 SW6010 UG/L 25 SW6010 UG/L 25 SW6010 UG/L 100 SW6010 UG/L 100			25 to 00 to		15 UJ 25 UJ
CLP UG/L 5 CLP UG/L 5 CLP UG/L 5 thane CLP UG/L 5 CLP UG/L 5 CLP UG/L 5 CLP UG/L 5 CLP UG/L 5 SW6010 UG/L 500 SW6010 UG/L 500 SW6010 UG/L 25 SW6010 UG/L 25 SW6010 UG/L 100 SW6010 UG/L 100			2 p s s s		2 2 S
CLP UG/L 5 CLP UG/L 5 CLP UG/L 5 CLP UG/L 5 CLP UG/L 5 CLP UG/L 5 CLP UG/L 5 CLP UG/L 5 SW6010 UG/L 500 SW6010 UG/L 25 SW6010 UG/L 25 SW6010 UG/L 100 SW6010 UG/L 100 SW6010 UG/L 100			55 C		2 51
Oromethane CLP UG/L 5 Ioromethane CLP UG/L 5 Oluble CLP UG/L 5 Oluble SW6010 UG/L 6 Auble SW6010 UG/L 500 Auble SW6010 UG/L 50 Auble SW6010 UG/L 25 Auble SW6010 UG/L 25 Auble SW6010 UG/L 25 Auble SW6010 UG/L 100 Auble SW6010 UG/L 100			> > > =		58
oromethane CLP UG/L 5 CLP UG/L 5 Oluble SW6010 UG/L 6 Otal SW6010 UG/L 500 Auble SW6010 UG/L 500 Ital SW6010 UG/L 25 SW6010 UG/L 25 SW6010 UG/L 26 SW6010 UG/L 100			⊃ : 'o '		1
CLP UG/L 5 CLP UG/L 6 CLP UG/L 6 Otal SW6010 UG/L 500 tuble SW6010 UG/L 500 tal SW6010 UG/L 25 tal SW6010 UG/L 100 SW6010 UG/L 100			=		15
CLP UG/L 6 CLP UG/L 500 Cotal SWe010 UG/L 500 Cotal SWe010 UG/L 500 Cotal SWe010 UG/L 25 Cotal	D 45		o 0	.s.	ი 2
SW6010 UG/L SW6010 UG/L SW6010 UG/L SW6010 UG/L SW6010 UG/L	-		7 7	⊃	-
SW6010 UG/L SW6010 UG/L SW6010 UG/L SW6010 UG/L SW6010 UG/L				-	
SW6010 UG/L SW6010 UG/L SW6010 UG/L SW6010 UG/L	200	D 0005			
SW6010 UG/L SW6010 UG/L SW6010 UG/L	200		2000 n		85700
SW6010 UG/L SW6010 UG/L	25	72 N			
SW6010 UG/L	25		25 U		39.4
LONGO 1	100	·	100 U		9 2
	2000	D 0005		-	
Magnesium, Total SW6010 UG/L 5000	2000		2000		25300
SW6010 UG/L	2000	2000 N			
Sodium, Total SW8010 UG/L 5000	5000		5000 U ,		65700

DETECTED CONCENTRATIONS FOR QUALITY ASSURANCE SAMPLES (Round 1. November, 1990) HULMAN ANG

			REPTD	LOCATION	MW0-02 ET = 82	MW0-02 T2-80	MW0-03 T8 - 00	MWB-01 E1_78	MWB-01 F1 - 78
PARAMETER	METHOD UNITS			Depth, FT	0.0-0.0	0.0-0.0	0.0-0.0	0.0-0.0	0.0-0.0
VOLATILE ORGANICS									
Acetone	CLP	UG/L	10			2	3		12 UJ
Carbon Disulfide	CLP	UG/L	ıo			⊃ \$6	7 9		200
Chloroform	CLP	UG/L	ı,			25	2		2 0.7
Bromodichloromethane	CLP	UG/L	ıo			⊃ \$3	2 0		2 0
Dibromochloromethane	CLP	UG/L	د			⊃ \$	2 0		2 C
Bromoform	CLP	UG/L	w			20	2 0		⊃ \$6
Toluene	CLP	UG/L	ĸ			20	2 C		2 0
METALS									
Calcium, Soluble	SW6010	UG/L	200		81300			2000 n	
Calcium, Total	SW6010	UG/L	200						O 0009
Copper, Soluble	SW6010	UG/L	25		28.8			25 U	
Copper, Total	SW6010	UG/L	52						52 ∩
Iron, Total	SW6010	UG/L	100						100 C
Magnesium, Soluble	SW6010	UG/L	2000		24100			O 0005	
Magnesium, Total	SW6010	UG/L	2000						O 0005
Sodium, Soluble	SW6010	UG/L	2000		63900			2000 U	
Sodium, Total	SW6010	UG/L	2000						2000 U

DETECTED CONCENTRATIONS FOR QUALITY ASSURANCE SAMPLES (Round 1. November, 1990) HULMAN ANG

PARAMETER	METHOD UNITS	SLIND	REPTD I	LOCATION U - ID Depth, FT	SEB-01 E1 - 96 0.0-0.0	SEO-01 T1 - 98 0.0-0.0	880-01 T1 - 56 90101110-008	536-01 E1 - 58 0-0 0010[18]_003	SSB-01 E1 - 56 0-0
VOLATILE ORGANICS									
Acetone	CLP	UG/L	5		12 UJ	4 5	~ ~	37 W	3 0
Carbon Disulfide	CLP	UG/L	S		20	2	20	<u>ہ</u>	<u>ي</u>
Chloroform	CLP	UG/L	S.		77	25 C	2 0	7	2
Bromodichloromethane	CLP CLP	UG/L	10		2	2	25	D 9	2 C
Dibromochloromethane	占	UG/L	ro.		2 0	2	⊃ S	S	
Bromoform	CLP	UG/L	10		<u>ح</u>	⊃ \$3	⊃ œ	ک د	
Toluene	먑	UG/L	9		2	2	2 C	S S	ۍ ت
METALS									
Calcium, Soluble	SW6010	UG/L	200						
Calcium, Total	SW6010	NG/L	200		D 0009			⊃ 00Z	200 C
Copper, Solubie	SW6010	UG/L	25					-	
Copper, Total	SW6010	UG/L	25		25 U			22 N	52 ∩
Iron, Total	SW6010	NG/L	100		100 U			4 ⊃	울 그
Magnesium, Soluble	SW6010	UG/L	2000						
Magnesium, Total	SW6010	UG/L	2000		2000 n			⊃ 002	500 €
Sodium, Soluble	SW6010	UG/L	2000						
Sodium, Total	SW6010	UG/L	2000		5000 U			D 006	D 006

DETECTED CONCENTRATIONS FOR QUALITY ASSURANCE SAMPLES (Round 1. November, 1990) HULMAN ANG

PARAMETER	METHOD UNITS	UNITS	REPTD DETECT LIMIT	LOCATION U - ID Depth, FT LAB ID #	SSO-02 12- 57 9010L151-016	SWB-01 E1 - 99 0.0-0.0 9011L576-013	SWB-01 E1 - 98 0.0-0.0 90111,576-005
VOLATILE ORGANICS							
Acetone	CLP	UG/L	2		15 UJ		3 8
Carbon Disulfide	CLP	UG/L	9		⊃ s		5 U
Chloroform	CLP	UG/L	2		2 0		7
Bromodichloromethane	CLP	Na/L	10		2 C		ე ა
Dibromochloromethane	CLP	UG/L	6		2 0		20
Bromoform	GLP	NG/L	40		2 0		25
	CLP	UG/L	16		2 C		2 C
METALS							
Calcium, Soluble	SW6010	UG/L	8			2000 n	
Calcium, Total	SW6010	UG/L	20				2000 N
Copper, Soluble	SW6010	UG/L	25			72 N	
Copper, Total	SW6010	UG/L	25				25 U
Iron, Total	SW6010	UG/L	5				100 U
Magnesium, Soluble	SW6010	NG/L	2000			2000 n	
Magnesium, Total	SW6010	UG/L	2000				2000 N
Sodium, Soluble	SW6010	UG/L	2000			2000 n	
Sodium, Total	SW6010	NG/L	2000				2000 N

DETECTED CONCENTRATIONS FOR QUALITY ASSURANCE SAMPLES (Round 2. January, 1992) HULMAN ANG

			_ +	LOCATION U - ID	MW0-01 FD -	MW0-01 FD -	MW0-01 FD -	MW0-01 T1-	MW0-02 FT -
PARAMETER	METHOD UNITS	STIND	LIMIT	Depth, FT LAB ID #	140 9201L030002	140R 9201L056-010	140R 9201L056-014	117 9201L030-003	141 8201L030-001
VOLATILE ORGANICS									
1,1,1-Trichloroethane	CLP	UG/L	2		T) 89			- - - -	- P
Bromodichforomethane	CL _P	UG/L	5		10 t			5 C	4
Dibromochloromethane	CLP	UG/L	2		5 U			10 D	12
Bromoform	CLP	UG/L	2		5			□	7 8
METALS									
Catcium, Total	SW6010	Ng/L	2000			O000		•	
Copper, Total	SW6010	UG/L	25			25 U			
Sodium, Total	SW6010	UG/L	2000			2000 N			
Calcium, Soluble	SW6010	UG/L	2000				D 0005		
Copper, Soluble	SW6010	UG/L	25				25 U		-
Sodium, Soluble	SW6010	UG/L	2000				2000 U		

DETECTED CONCENTRATIONS FOR QUALITY ASSURANCE SAMPLES (Round 2. January, 1992) HULMAN ANG

PARAMETER	METHOD UNITS	UNITS	REPTD DETECT LIMIT	LOCATION U = ID Depth; FT LAB ID #	MW0-02 FT - 141R 9201L058-015	MW0-02 FT - 141R 9201L056-011	MW0-02 72- 118 9201L058-005	MW0-03 T3- 118 92011.068-003	MW0-04 T4 - 120 9201L073-003
VOLATILE ORGANICS									
1,1,1-Trichloroethane	다	J D D	-	- 40			으 우	⊃ ₽	₽
Bromodichloromethane	CL _P	UG/L	9				5 U	₽	10 C
Dibromochloromethane	CLP	UG/L	2				5 U	2	۵ د
Bromoform	CLP	UG/L	2		-		0 0	5 C	9
METALS									
Calcium, Total	SW6010	UG/L	2000			10800			
Copper, Total	SW6010	UG/L	25			જ્ઞ			
Sodium, Total	SW6010	Na/L	2000			178000			
Catcium, Soluble	SW6010	UG/L	2000		10700				
Copper, Soluble	SW6010	UG/L	25		33.2			-	
Sodium, Soluble	SW6010	Na/L	2000		175000				

DETECTED CONCENTRATIONS FOR QUALITY ASSURANCE SAMPLES (Round 2. January, 1992) HULMAN ANG

PARAMETER	METHOD UNITS		REPTD I	LOCATION U - ID Depth, FT LAB ID #	MW1-08 E2 - 134 9201L058-013	MW1-06 E2 - 134 9201L056-017	MWB-01 E1 - 133 9201L056-012	MWB-01 E1- 133 8201[058-018	SS6-16 E2 - 134 9201L056-001
VOLATILE ORGANICS									
1,1,1-Trichloroethane	다	UG/L	2		10 U		10 U		- - -
	CLP CLP	UG/L	9		10 U		10 C		- P
Dibromochloromethane		UG/L	\$		10 U		-10 -C		⊃ ¢
Bromoform	CLP CLP	UG/L	9		10 U		10 U		n e
METALS									• :
Calcium, Total	SW6010	UG/L	2000		2000 n		2000 U		2000 C
Copper, Total	SW6010	UG/L	25		52 ∩		2 5 U		25 U
Sodium, Total	SW6010	UG/L	2000		O005		O009		2000
Calcium, Soluble	SW6010	UG/L	2000			D 0009		2000 C	
Copper, Soluble	SW6010	UG/L	25			25 U		25 U	
Sodium, Soluble	SW8010	UG/L	2000			2000 U		2000 U	

DATA VALIDATION AND DATA QUALITY SUMMARY

Samples collected at the 181st TFG were submitted for analysis at a HAZWRAP-approved laboratory, Weston Analytical of Lionville, PA. Soil, sediment, groundwater and surface water samples were analyzed for target compound list (TCL) volatile organics, TCL semivolatile organics, and total petroleum hydrocarbons (TPH). Samples from all sites except Sites 2 and 4 were also analyzed for target analyte list (TAL) metals and pesticides/PCBs.

The intention of the sampling and analysis effort was to produce data of acceptable quality which would allow for an accurate evaluation of the vertical and horizontal distribution of contamination at the site. The main quality assurance (QA) objectives for this work is that all measurements be precise, accurate and representative of the actual site conditions and that all data resulting from sampling and analysis be comparable and complete. These objectives were met by performing certain field and laboratory quality control (QC) activities.

To ensure that the data quality objectives were met, M&E evaluated the sample and QC analytical data as stated in the QAPP using HAZWRAP Level C data validation guidelines, as outlined in the HAZWRAP/DOE documents:

"Requirements for Quality Control of Analytical Data", August

"Requirements for Quality Control of Analytical Data", July 1990

The first round of samples, collected in October and November 1990, were analyzed according to criteria set forth in the "CLP SOW 2/88" and were validated using the HAZWRAP, August 1988 validation guidelines, while the second round of samples, collected in January 1992 were analyzed according to criteria set forth in the "CLP SOW 3/90" and were validated using the HAZWRAP, July 1990 validation guidelines.

The following pages present a discussion of the QA/QC summary results.

DATA QUALITY SUMMARY

The overall quality of the data is summarized in terms of the precision, accuracy, representativeness, comparability, and completeness (PARCC) parameters. This discussion is based on the data validation results summaries which are attached.

Precision

Precision is a measure of agreement among individual measurements of the same property under similar conditions. It is expressed in

terms of relative percent difference (RPD) between replicates. Precision was determined through the collection and analysis of field duplicates for all matrices, namely surface soils, subsurface soils, sediments, surface water, and groundwater. Precision for these matrices was also evaluated through the use of matrix spike and matrix spike duplicate analyses.

Accuracy

Accuracy is defined as the degree of agreement of a measurement (or measurement average) with an accepted reference or true value. It is a measure of system bias and is usually expressed as a percentage of the true value. Accuracy was assessed through the results of initial and continuing calibration checks, surrogate recoveries and the recoveries of spiked compounds for MS/MSD samples, in addition to the analysis of lab blanks, trip blanks, equipment blanks and field duplicates.

Accuracy of VOC Analyses. The accuracy of VOC analyses was affected due to QC issues relating to blank contamination and calibration problems. Blank contamination with methylene chloride, acetone, carbon disulfide, and chloroform was apparent in laboratory method blanks and trip and equipment blanks associated with both the water and the soil samples. Analysis of source water used for decontamination of field equipment resulted in the detection of low levels of acetone, methylene chloride and carbon disulfide.

Accuracy of SVOC Analyses. Blank contamination was apparent in both laboratory method blanks and field equipment blanks, and affected the detection di-n-butylphthatlate, bis(2-ethylhexyl)phthalate in field samples, both soil and water. The data from a few samples, containing high concentrations of these were accepted as positive detections, however, the majority of these were qualified as not detectable above the blank contaminant action level concentration.

Surrogate recoveries met criteria for the most part, however, poor surrogate recoveries were apparent in a few of the analyses. The lab usually reanalyzed the samples for those that were way out of criteria. Low surrogate recoveries resulted in the estimation of both detected and non-detected compound quantification.

Other quality control problems include exceeding holding time criteria (for the Round 2 soils which had to be reanalyzed for reasons stated in the validation summaries), and calibration problems.

Accuracy of Pesticide/PCB Analyses. Minor problems were evident from the validation of the Pesticide/PCB data, the most significant of which resulted in the flagging of results for three samples due to exceedance of holding times. Some soil data was also flagged due to high MS/MSD and BS/BSD recoveries for a few compounds.

Accuracy of Metals Analyses. Validation criteria relating to the accuracy of metals analyses were met except for blanks and MS/MSDs. Blank contamination, mainly zinc, was apparent in laboratory blanks and field blanks (i.e. equipment and source water blanks). Matrix spike recoveries were often outside of criteria for a number of compounds including, but not limited to antimony, arsenic, selenium, thallium, magnesium, sodium, and potassium. The data was qualified accordingly.

Accuracy of TPH Analyses. The only criteria which was not met 100% for the TPH analyses was the blank analysis for two batches of samples. Contamination of the equipment blank was apparent for those two cases.

Representativeness

Representativeness expresses the degree to which data accurately and precisely represents a characteristic of a data population, a sampling point or an environment. For this site investigation, grab samples were taken, and such samples are strictly representative only of the conditions at the location and time collected, within sampling and analytical error. Samples were handled and preserved properly and most of the analyses were performed within holding times the data, so that it is expected that the data is fairly representative of conditions in the area sampled.

Comparability

Comparability expresses the confidence with which one data set can be compared to another. Sampling and analysis procedures consistent with HAZWRAP and EPA CLP protocols were used for each specific site and in both sampling rounds so that all data sets are comparable within a specific site and between sites at the 181st TFG. As stated earlier, the samples from Round 2 were analyzed using the "3/90 SOW" which was not yet in use during the earlier sampling round, however, this does not affect the comparability of the data. Data are reported in consistent units of ug/l, mg/l, and ug/kg.

Completeness

Completeness is a measure of the amount of valid data obtained after analysis compared to the amount of samples collected. It is usually expressed as a percentage. All samples collected arrived at the laboratory intact and were analyzed to produce valid data. Data validation resulted in the rejection of only a minor amount of the data, mainly for non-detects of arsenic, lead and mercury in some Site 1 and Site 6 soils due to low MS/MSD recoveries. The VOA fraction for one Site 6 borehole soil was also rejected because the surrogates were diluted out. The non-detect results for 2-butanone which were rejected for the Round 2 samples did not meet the HAZWRAP validation calibration criteria, but they do meet the new "3/90 SOW analytical criteria."

Completeness was greater than 95% for the combined sampling rounds.

DATA VALIDATION RESULTS

DATA SUMMARY KEY

- A Acceptable Data.
- J The associated numerical value is an estimated quantity.
- R Reject data due to quality control criteria. The data are unusable (compound may or may not be present). Resampling and reanalysis is necessary for verification.
- U The compound was analyzed for but was not detected. The associated numerical value is the sample quantitation limit.
- UJ The compound was analyzed for but was not detected. The sample quantitation limit is an estimated quantity.

HULMAN DATA VALIDATION RESULTS SUMMARY

Case No. RFW9010L110

9 Soils: BHB-01-NS-01-2.0-4.0, BHB-01-NS-02-4.0-6.0, SS5-03-NS-43-0.0-0.5, SS5-04-NS-44-0.0-0.5, SS5-05-NS-45-0.0-0.5, SSB-01-NS-41-0.0-0.5, SSB-02-NS-42-0.0-0.5, SS2-08-NS-48-0.0-0.5, SS2-09-NS-49-0.0-0.5

3 Aqueous: SSB-01-E1-58-0-0, SS0-01-T1-56, BH0-01-T1-31

A validation was performed on the organic and inorganic analytical data from Case No. RFW#9010L110 low level soils and low level aqueous samples collected by M&E at the Hulman Municipal Airport site. The data was evaluated based on the following parameters:

- * . data completeness
- * . holding times
- * . GC/MS Tuning
- * . calibration
 - . blanks
 - . blank/spike control samples
- * . blank/spike laboratory control samples
 - surrogate recoveries
 - . matrix spike/matrix spike duplicate
 - pesticide instrument (GC) performance
- * All criteria were met for this parameter.

Table I summarizes the validation recommendations which were based on the following information:

ORGANICS

Blanks:

The semivolatile, pesticide/PCB and TPH blanks contained no contaminants. The volatile lab, equipment and trip blanks are summarized below:

Compound	Max. Conc.	Action Level
Low Level:		
Methylene Chloride	17 ug/kg	170 ug/kg (ug/l)
Acetone	35 ug/kg	350 ug/kg (ug/l)
Chloroform	1 ug/kg	5 ug/kg

Blank Actions:

- . value < action level; report value followed by a UJ
- value > action level; report value unqualified

The action levels were compared to sample values and the appropriate data qualifications were made.

Blank/Spike Control Sample (BS/BSD):

The VOA and pesticide/PCB BS/BSD samples met QC criteria. Recovery of 2,4-dinitrotoluene (99%) was high for the aqueous SVOA blank/spike control sample. No action was necessary however, since the compound was not detected in the samples.

Matrix Spike / Matrix Spike Duplicate:

Soil matrix spike recoveries were high for the semivolatile and pesticide / PCB analyses. The semivolatile compounds which were affected are phenol (102), n-nitroso-di-n-propylamine (133), 4-chloro-3-methylphenol (118), 4-nitrophenol, 2,4-dinitrotoluene (105) and pentachlorophenol (114). The affected pesticide / PCB compounds include lindane (305), heptachlor (305), aldrin (283), dieldrin (312), endrin (360), and 4,4'-DDT (380). All positive results for these compounds were flagged as estimated (J) and non-detects were accepted since no recoveries were below 10%.

Surrogate Recoveries:

Surrogate recoveries were within the QC limits for the VOA and SVOA fractions. The pesticide / PCB fraction showed interference with the recovery of dibutylchlorendate. Sample results were therefore qualified as estimated, UJ for non-detects and J for positive results.

Pesticide Instrument (GC) Performance:

Retention time windows were outside of criteria for endosulfan II and methoxychlor in one Ind-C standard. Initial calibration was out for aldrin on the quantitation column, and the continuing calibration for alpha-BHC was out for sample SSB-01-NS-41-0.0-0.5. No sample results were affected, therefore no action was necessary.

INORGANICS

All criteria were met for holding times, calibration, lab control sample (LCS) and LCS duplicate spike for all samples.

Blanks:

Beryllium contamination was found in the soil blank and, as a result, all beryllium hits in the soil samples were flagged as estimated (UJ) since they were all below the action level of 2.4 mg/kg.

Matrix Spike / Matrix Spike Duplicate:

Soil matrix spike recoveries were low for silver, arsenic, lead, antimony, and selenium. Results for these analytes were flagged as estimated; J for positive values and UJ for non-detects. There were no non-detects for lead, else these would have been rejected (R) since MS recovery for lead was below 30%.

Recoveries for aluminum, calcium, iron, magnesium, sodium, potassium, and thallium were higher than the upper limit of 125%. All non-detects hits for these analytes were estimated (J) for all soil samples.

The water matrix spike recoveries were high for calcium, potassium, magnesium, and sodium, however data is not affected since there were no detects.

Note: The calibration criteria (90-100% for ICP and AA metals and 85-115% for Hg) which the lab reported in their case narrative is different from that (90-110% for ICP/AA and 80-120% for Hg) stated in the QAPP and on Form 2A. This does not affect the data however.

Hulman Field RFW # 9010L110

TABLE I. RECOMMENDATIONS SUMMARY

SAMPLE ID#	VOA	SVOA	PEST/PCB	METALS	TPH
BHB-01-NS-01-2.0-4.0	A^3	A	A	A^4, J^5, J^6	A
BHB-01-NS-02-4.0-6.0	A^3	A	J⁴	A^4, J^5, J^6	A
SS5-03-NS-43-0.0-0.5	A^2	A	A	A^4, J^5	A
SS5-04-NS-44-0.0-0.5	${\mathtt A}^2$	A	J⁴	A^4, J^5	A
SS5-05-NS-45-0.0-0.5	A^2	\mathcal{J}^1	$\mathbf{J}^{3,}\mathbf{J}^{4}$	A^4, J^5, J^6	A
SS2-08-NS-48-0.0-0.5	A^2	A			A
SS2-09-NS-49-0.0-0.5	A^2	A			A
SSB-02-NS-42-0.0-0.5	\mathtt{A}^2	A	A	A^4, J^5, J^6	A
SSB-01-NS-41-0.0-0.5	\mathtt{A}^2	A	\mathtt{J}^4	A^4, J^5, J^6	Α
SSB-01-E1-58-0-0	A^2	$\boldsymbol{J^2}$	A	A	A
SS0-01-T1-56	A^1				
BH0-01-T1-31	A^1				

- A Accept all data.
- A¹ Accept data but flag as non-detect (UJ) all positive values for methylene chloride less than the action level due to blank contamination.
- ${\rm A}^2$ Accept data but flag as non-detect (UJ) all positive values for methylene chloride and acetone less than the action level due to blank contamination.
- A³ Accept data but flag as non-detect (UJ) all positive values for methylene chloride, acetone, and chloroform less than the action level due to blank contamination.
- A⁴ Accept data but flag as non-detect (UJ) all positive results for beryllium less than 2.4 mg/kg due to blank contamination.
- J¹ Qualify as estimated (J) all positive results for n-nitroso-di-n-propylamine, 4-chloro-3-methylphenol, 4-nitrophenol, 2, 4-dinitrotoluene and pentachlorophenol due to high matrix spike recoveries.
- J₂ Estimate (J) positive values for 2,4-dinitrotoluene and 1,4-dichlorobenzene due to high blank spike recovery.
- J³ Qualify as estimated (J) positive results for lindane, aldrin, heptachlor, dieldrin, endrin, and 4,4'-DDT due to high matrix spike recoveries.
- J4 Qualify as estimated (J) all positive results and (UJ) all non-detects for all compounds due to interference with the recovery of the surrogate compound dibutylchlorendate.
- J⁵ Qualify as estimated (J) all positive results and (UJ) all non-detects for silver, arsenic, antimony, lead, and selenium due to low matrix spike recoveries.
- J⁶ Estimate (J) positive values for calcium, magnesium, sodium, potassium, and thallium due to high matrix spike recoveries.
- -- The sample was not analyzed for these parameters.

HULMAN DATA VALIDATION RESULTS SUMMARY

Case No. RFW9010L151

12 Soils: BH5-02-NS-03-3.0-5.0, BH5-02-NS-04-5.0-7.0, BH5-03-NS-05-1.0-3.0, BH5-03-NS-06-5.0-7.0, SS1-12-NS-52-0.0-0.5, SS1-13-NS-53-0.0-0.5, SS4-10-NS-50-0.0-0.5, SS4-11-NS-51-0.0-0.5, SS4-15-NS-55-0.0-0.5, SS6-06-NS-46-0.0-0.5, SS6-07-NS-47-0.0-0.5, SS6-14-NS-54-0.0-0.5,

7 Aqueous: BH5-03-E1-36-0-0, BH5-02-T2-32-0-0, SS6-01-E1-58-0-0, SS0-02-T2-57, BH0-00-F1-39, BH0-00-F2-40, BH0-00-F3-59

A validation was performed on the organic and inorganic analytical data from Case No. RFW#9010L151 low and medium level soils and low level aqueous samples collected by M&E at the Hulman Municipal Airport site. The data was evaluated based on the following parameters:

- * . data completeness
- * . holding times
- * . GC/MS Tuning
 - calibration
 - blanks
 - blank/spike control samples
- * . blank/spike laboratory control samples
- * . surrogate recoveries
 - . matrix spike/matrix spike duplicate
 - pesticide instrument (GC) performance
- * All criteria were met for this parameter.

Table I summarizes the validation recommendations which were based on the following information:

ORGANICS

Calibration:

The VOA, SVOA, and TPH calibrations all met QC criteria. The %RSDs for the pesticide initial and continuing calibrations exceeded the 10% criteria, however no action was necessary since there were no positive results.

Blanks:

The semivolatile, pesticide/PCB and TPH blanks contained no contaminants. The volatile lab, equipment and trip blanks are summarized below:

	Compound	Max. Conc.	Action Level
Low Level	: Methylene Chloride	8 ug/kg	80 ug/kg (ug/L)
	Acetone	20 ug/kg	200 ug/kg (ug/L)
	Chloroform	1 ug/kg	5 ug/kg
	Carbon Disulfide	1 ug/L	5 ug/L
Med. Leve	l: Methylene Chloride	1700 ug/kg	17000 ug/kg
	Acetone	1800 ug/kg	18000 ug/kg
	Chloroform	125 ug/kg	625 ug/kg

Blank Actions:

- . value < action level; report value followed by a UJ
- value > action level; report value unqualified

The action levels were compared to sample values and the appropriate data qualifications were made.

Blank/Spike Control Sample (BS/BSD):

Compound	<pre>% Recovery</pre>	<u>QC Limits</u>
Pentachlorophenol	13	17 - 109
Dieldrin	160	31 - 134
Endrin	151	42 - 139
4,4'-DDT	187	23 - 134

Positive results for these compounds will be flagged as estimated (J) and non-detects will be accepted since no recoveries were below 10%.

Surrogate Recoveries:

One surrogate standard for the acid fraction of the SVOAs had a recovery greater than the required specification. No qualifying actions were necessary however.

Pesticide Instrument (GC) Performance:

Retention time windows were outside of criteria for endosulfan II and methoxychlor in the Ind-A standard. This Ind-A was the last one in the 72-hr sequence and did not affect any data.

INORGANICS

All criteria were met for holding times, calibration, lab control sample (LCS) and LCS duplicate spike for all samples.

Blanks:

Zinc contamination was found in the aqueous method blank and, as a result, all positive zinc results for the water samples were flagged as estimated (UJ) since they were all below the action level of 180 ug/l.

Matrix Spike / Matrix Spike Duplicate:

Soil matrix spike recoveries were low for antimony, copper, manganese, selenium, and thallium; therefore results for these were flagged as estimated (J for positive values and UJ for non-detects) Recoveries for potassium, magnesium, and sodium were high (>125%), so hits for these analytes were flagged as estimated (J) for all soil samples.

Water matrix spike recoveries were also high for calcium, potassium, magnesium, and sodium, so hits for these analytes were flagged as estimated (J) for all water samples.

Note: The calibration criteria (90-100% for ICP and AA metals and 85-115% for Hg) which the lab reported in their case narrative is different from that (90-110% for ICP/AA and 80-120% for Hg) stated in the QAPP and on Form 2A. This does not affect the data however.

Hulman Field RFW # 9010L151

TABLE I. RECOMMENDATIONS SUMMARY

SAMPLE ID#	VOA	SVOA	PEST/PCB	METALS	TPH
BH5-02-NS-03-3.0-5.0	\mathbf{A}^1	\mathcal{J}^1		J⁴	A
BH5-02-NS-04-5.0-7.0	${f A^1}$	\mathcal{J}^1		J ⁴	A
BH5-03-NS-05-1.0-3.0	${f A}^1$	\mathcal{J}^1		J⁴	A
BH5-03-NS-06-5.0-7.0	${f A}^1$	$\boldsymbol{\mathcal{J}}^1$		J⁴	A
SS1-12-NS-52-0.0-0.5	${f A^1}$	\mathcal{J}^1	J^2	J⁴.	A
SS1-13-NS-53-0.0-0.5	${f A^1}$	\mathcal{J}^1	\mathbf{J}^2	J⁴	A
SS4-10-NS-50-0.0-0.5	${\mathtt A}^1$	$\boldsymbol{\mathcal{J}}^1$			A
SS4-11-NS-51-0.0-0.5	\mathbb{A}^1	\boldsymbol{J}^1			A
SS4-15-NS-55-0.0-0.5	\mathbb{A}^1	\boldsymbol{J}^1			A
SS6-06-NS-46-0.0-0.5	\mathbb{A}^1	\boldsymbol{J}^1	\mathtt{J}^2	J⁴,J⁵	A
SS6-07-NS-47-0.0-0.5	${\mathbb A}^1$	\mathcal{J}^1	${\tt J}^2$	J⁴,J⁵	A
SS6-14-NS-54-0.0-0.5	${\mathbb A}^1$	\mathcal{J}^1	\mathtt{J}^2	J⁴,J⁵	A
BH5-03-E1-36-0-0	${\mathtt A}^2$	A	A	A	A
BH5-02-T2-32-0-0	${\mathtt A}^2$				
SS6-01-E1-58-0-0	${\mathtt A}^2$	A	A	A	A
SS0-02-T2-57	A^2				
BH0-00-F1-39	A^2	A	A	A_{α}^{3}, J^{3}	A
BH0-00-F2-40	\mathbb{A}^2	A	A	A_{a}^{3}	A
BH0-00-F3-59	\mathbf{A}^2	A	A	\mathcal{J}^3	A

A - Accept all data.

A¹ - Accept data but estimate (UJ) all positive values for acetone, methylene chloride and chloroform greater than the CRQL but less than the action level due to blank contamination.

 ${\tt A}^2$ - Accept data but estimate (UJ) all positive values for acetone, methylene chloride and carbon disulfide greater than the CRQL but less than the action level due to blank contamination.

A³ - Accept data but estimate (UJ) all positive values for zinc less than 180 ug/l due to blank contamination.

J¹ - Estimate (J) all positive results for pentachlorophenol due to low blank spike recovery.

 J^2 - Estimate (J) all positive results for dieldrin, endrin, and 4,4'-DDT due to high blank spike recovery.

J³ - Estimate (J) all positive results for calcium, magnesium and sodium due to high water matrix spike recovery.

J⁴ - Estimate (J) all positive results and estimate (UJ) all negative results for antimony, copper, selenium, and thallium due to low soil matrix spike recoveries.

 J^5 - Estimate (J) all positive results for magnesium, sodium and potassium due to high soil matrix spike recoveries.

-- - The sample was not analyzed for this parameter.

HULMAN DATA VALIDATION RESULTS SUMMARY

Case No. RFW9010L152

6 Soils: BH2-07-NS-13-2.0-4.0, BH2-07-NS-14-4.0-6.0,

BH2-08-NS-15-0.0-2.0, BH2-08-NS-16-4.0-6.0,

BH2-09-NS-17-2.0-4.0, BH2-09-NS-18-4.0-6.0,

1 Aqueous: BH0-03-T3-33-0-0

A validation was performed on the organic analytical data from Case No. RFW#9010L152 low and medium level soils and low level aqueous samples collected by M&E at the Hulman Municipal Airport site. The data was evaluated based on the following parameters:

- * . data completeness
- * . holding times
- * . GC/MS Tuning
- * . calibration
 - blanks
- * . blank/spike control samples
- * . surrogate recoveries
 - . matrix spike/matrix spike duplicate
- * All criteria were met for this parameter.

Table I summarizes the validation recommendations which were based on the following information:

Blanks:

The semivolatile and TPH blanks contained no contaminants. The volatile laboratory, trip and equipment blanks are summarized below:

	Compound	Max. Conc.	Action Level
Low Level	: Methylene Chloride	17 ug/kg	170 ug/kg
	Acetone	31 ug/kg	310 ug/kg
*	Carbon Disulfide	10 ug/l	50 ug/kg
Med. Leve	l: Methylene Chloride	1700 ug/kg	20000 ug/kg
	Acetone	1800 ug/kg	53000 ug/kg
*	Carbon Disulfide	10 ug/l	6250 ug/kg

Blank Actions:

- . value < action level; report value followed by a UJ
- value > action level; report value unqualified
- * carbon disulfide was found in the equipment blank only.

The action levels were compared to sample values and the appropriate data qualifications were made.

Matrix Spike / Matrix Spike Duplicate:

The volatile percent recoveries were within the specified criteria. For the semivolatile matrix spike, phenol, 2-chlorophenol, 4-chloro-3-methylphenol, and 2,4-dinitrotoluene all had slightly high percent recoveries. No action was necessary however, since there were no positive results.

Hulman Field RFW # 9010L152

TABLE I. RECOMMENDATIONS SUMMARY

SAMPLE ID#	VOA	SVOA	TPH	
BH2-07-NS-13-2.0-4.0	A^1	A	A	
BH2-07-NS-14-4.0-6.0	\mathbf{A}^1	A	A	
BH2-08-NS-15-0.0-2.0	A^1	A	A	
BH2-08-NS-16-4.0-6.0	${\tt A}^1$	A	A	
BH2-09-NS-17-2.0-4.5	A^1	A	A	
BH2-09-NS-18-4.0-6.5	A^1	A	A	
BH0-03-T3-33-0-0	A^2			

A - Accept all data.

A¹ - Accept data but flag as non-detect (UJ) all positive values for acetone, methylene chloride and carbon disulfide less than the action level due to blank contamination.

 $^{{\}tt A}^2$ - Accept data but flag as non-detect (UJ) all positive values for methylene chloride less than 80 ug/l due to blank contamination.

J¹ - Estimate (J) positive results for phenol, 2-chlorophenol, 4-chloro-3-methylphenol, and 2,4-dinitrotoluene due to high matrix spike recoveries.

^{-- -} The sample was not analyzed for this parameter

HULMAN DATA VALIDATION RESULTS SUMMARY

Case No. RFW9010L166

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18 Soils: BH6-04-NS-07-2.0-4.0, BH6-04-NS-08-4.0-6.0, BH6-05-NS-09-0.0-2.0, BH6-05-NS-10-4.0-6.0, BH1-14-NS-27-2.0-4.0, BH1-14-NS-28-4.0-6.0, BH1-15-NS-29-2.0-4.0, BH1-15-NS-30-4.0-6.0, BH2-06-NS-11-2.0-4.0, BH2-06-NS-12-4.0-6.0, BH4-10-NS-19-2.0-4.0, BH4-10-NS-20-4.0-6.0, BH4-11-NS-21-2.0-4.0, BH4-11-NS-22-4.0-6.0, BH4-12-NS-23-2.0-4.0, BH4-12-NS-24-4.0-6.0, BH4-13-NS-25-2.0-4.0, BH4-13-NS-26-4.0-6.0, BH4-13-NS-25-2.0-4.0, BH4-13-NS-26-4.0-6.0, BH4-13-NS-25-2.0-4.0, BH4-13-NS-26-4.0-6.0, BH0-05-T5-35-0-0, BH0-04-T4-34-0-0
```

A validation was performed on the organic and inorganic analytical data from Case No. RFW#9010L166 low and medium level soils and low level aqueous samples collected by M&E at the Hulman Municipal Airport site. The data was evaluated based on the following parameters:

- * . data completeness
- * . holding times
- * . GC/MS Tuning
- * . calibration
 - blanks
 - . blank/spike control samples
 - blank/spike laboratory control samples
 - . surrogate recoveries
 - . matrix spike/matrix spike duplicate
 - pesticide instrument (GC) performance
- * All criteria were met for this parameter.

Table I summarizes the validation recommendations which were based on the following information:

ORGANICS

Blanks:

The organic blanks are summarized in the following table which shows the maximum contaminant concentration in any of the lab, equipment or trip blanks:

	Compound	Max. Conc.	Action Level
Low Level	-	20 ug/l	200 ug/kg (ug/l)
	Methylene Chloride	20 ug/1	200 ug/kg (ug/1)
	Acetone	31 ug/kg	310 ug/kg (ug/l)
	Carbon Disulfide	10 ug/l	50 ug/kg (ug/l)
	Benzoic Acid	60J ug/l	5 ug/l
	4-Chloroaniline	360J ug/kg	1800 ug/kg
	4,4'-DDD	0.090J ug/l	0.450 ug/l
	4,4'-DDE	0.10 ug/l	0.50 ug/l
	ТРН	4.7 mg/kg	23.5 mg/kg
Med. Leve	1:		
2010	Methylene Chloride	2300 ug/kg	23000 ug/kg
	Acetone	1400 ug/kg	14000 ug/kg
	Trichloroethene	170J ug/kg	850 ug/kg

Blank Actions:

- . value < action level; report value followed by a UJ
- value > action level; report value unqualified

The action levels were compared to sample values and the appropriate data qualifications were made. No action was taken on the pesticide/PCB fraction since there were no positive results.

Blank/Spike Control Sample (BS/BSD):

The VOA BS/BSD sample met QC criteria. The aqueous pesticide/PCB fraction showed low recovery of 4,4'-DDT and alpha-BHC, while the soil BS/BSD SVOA and pesticide fractions had high recoveries for phenol and 2,4-dinitrotoluene and for endrin and 4,4'-DDT, respectively.

Positive results for these compounds will be flagged as estimated (J) and non-detects will be accepted since no recoveries were below 10%.

Surrogate Recoveries:

The surrogates which did not meet criteria are summarized below:

	VOA			SVOA		
TR#s	TOL	<u>BFB</u>	DCF	TBP		
BH6-05-NS-09-0.0-2.0	Dil	Dil	Dil			
BH4-10-NS-19-4.0-6.0				128		

All three surrogate compounds for the VOA fraction were diluted out of sample BH6-05-NS-09-0.0-0.2. All positive VOA results for this sample were qualified as estimated and all non-detects were rejected. No qualifying actions were necessary for the SVOA and pesticide/PCB fractions.

Matrix Spike/Matrix Spike Duplicates:

The volatile and semivolatile percent recoveries and relative percent differences were within the specified criteria. There was interference with the recovery of dieldrin, endrin, and 4,4'-DDT in the pesticide/PCB fraction. Positive results for these compounds will therefore be flagged as estimated. No MS/MSD was done on the medium level soil.

Pesticide Instrument (GC) Performance:

All 4,4'-DDT retention times were greater than 12 minutes, and a few compounds (in the very last standard) including 4,4'-DDT, methoxychlor, endosulfan II, and endosulfan sulfate were slightly outside of the established retention time windows. These did not affect the data since this was the last standard in the 72-hour sequence.

INORGANICS

All criteria were met for holding times and calibration.

Blanks:

Soil blank samples met criteria. One equipment blank and the method blank associated with the water samples contained zinc. As a result, all positive zinc results for the water samples were flagged as estimated (UJ) if the concentration was below the action level of 180 ug/l.

Blank Spike / Laboratory Control Sample:

The aqueous lab control sample (LCS) was within QC criteria. The solid LCS had a recovery below the lower limit (80%) for silver (66.1%) and above the upper limit (120%) for selenium (122%). No action was necessary for selenium since all samples were non-detects. Results for silver were estimated (UJ) however. They were no positive results for these compounds.

Matrix Spike / Matrix Spike Duplicate:

Water matrix spike recovery for mercury was high for one sample (E3-38) and low for the other (E2-37). Results for this analyte were flagged as estimated (J for positive values and UJ for non-detects) for the water samples.

Soil matrix spike recoveries were high for aluminum, calcium, iron, potassium, magnesium, manganese, and sodium. Positive results for Ca, K, Mg, and Na were flagged (J) as estimated. No action was necessary for Al, Fe, and Mn since the sample concentrations for these compounds were more than four times the spike concentration. Recoveries for arsenic, mercury, and thallium were below the lower recovery limit (<75%). Positive results for these three analytes were flagged (J) as estimated. Non-detects for Tl were also flagged as estimated (UJ) while, non-detects for arsenic and mercury were rejected (R).

Note: Laboratory incorrectly reported MS %recovery for As as 47.5%. A calculation using the result reported in the unspiked sample shows that the recovery was actually 18.7%.

Hulman Field RFW # 9010L166

TABLE I. RECOMMENDATIONS SUMMARY

SAMPLE ID#	VOA	SVOA	PEST/PCB	METALS	TPH
BH6-04-NS-07-2.0-4.0	A^2	\mathbf{A}^2	\mathbf{J}^2	J^4, J^5, J^6, R^2	A^4
BH6-04-NS-08-4.0-6.0	A^2	A ²		\mathbf{J}^4 , \mathbf{J}^5 , \mathbf{J}^6 , \mathbf{R}^2	A^4
BH6-05-NS-09-2.0-4.0	A^3, R^1	A^2 A^2	${f J}^2$ ${f J}$	4 , J^{5} , J^{6} , R^{2}	A^4
BH6-05-NS-10-4.0-6.0	A^2	Δ ²	J^2 J	4 , J^{5} , J^{6} , R^{2}	A^4
	A^2	A^2	J^1 , J^2 J^4	J^5 , J^6 , R^2	A^4
BH1-14-NS-27-2.0-4.0	A^2	A^2	J^2 J	, - , - ,	A^4
BH1-14-NS-28-4.0-6.0	A^2	A^2	${f J}^2$ ${f J}$		A ⁴
BH1-15-NS-29-2.0-4.0		A 2		4 7 6 p2	\mathbf{A}^4
BH1-15-NS-30-4.0-6.0	A^2	A^2	${f J}^2$ ${f J}$	4 , 6 , 2	A ⁴
BH2-06-NS-11-2.0-4.0	A^2	A^2			
BH2-06-NS-12-4.0-6.0	A^2	A^2			A^4
BH4-10-NS-19-2.0-4.0	\mathbb{A}^2	A^2			A^4
BH4-10-NS-20-4.0-6.0	\mathbb{A}^2	A^2			A^4
BH4-11-NS-21-2.0-4.0	${\mathtt A}^2$	A^2			A^4
BH4-11-NS-22-4.0-6.0	A^2	A^2			A^4
BH4-12-NS 23-2.0-4.0	A^2	A^2			${\mathtt A}^4$
BH4-12-NS-24-4.0-6.0	A^2	A^2			${f A}^4$
BH4-13-NS 25-2.0-4.0	A^2	A^2			\mathbb{A}^4
	A^2	\mathbf{A}^2			A^4
BH4-13-NS-26-4.0-6.0	A^{1}	A	\mathcal{J}^3	\mathtt{A}^{5} , \mathtt{J}^{7}	A^4
BH1-15-E3-38-0-0	A al		J^3	Α, , υ	A ⁴
BH4-12-E2-37-0-0	A^1	A	J		
BH0-05-T5-35-0-0	A^1				
BH0-04-T4-34-0-0	\mathbb{A}^1				

A - Accept all data.

A¹ - Accept data but estimate (UJ) all positive values for methylene chloride less than the action level due to blank contamination.

 $^{{\}rm A}^2$ - Accept data but estimate (UJ) all positive values for acetone, methylene chloride, benzoic acid and 4-chloroaniline less than the action level due to blank contamination.

 $^{{\}rm A}^3$ - Accept data but estimate (UJ) all positive values for acetone, methylene chloride, and trichloroethene less than the action level due to blank contamination.

 $^{{\}rm A}^4$ - Qualify as estimated (UJ) all positive values for TPH less than 23 mg/kg due to blank contamination.

A⁵ - Accept data but estimate (UJ) positive values for zinc less than 180 ug/l due to blank contamination.

 J^1 - Estimate (\bar{J}) positive results for dieldrin, endrin, and 4,4'-DDT due to MS/MSD interference.

 J^2 - Estimate (J) positive results for endrin, and 4,4'-DDT in soil samples due to high blank spike recovery.

J³ - Estimate (J) all positive results for alpha-BHC and 4,4'-DDT in water samples due to high blank spike recovery.

 J^4 - Estimate (UJ) non-detects for silver for all soil samples

because LCS and LCS spike duplicate did not meet criteria.

J⁵ - Estimate (J) positive results for calcium, magnesium, potassium and sodium for all soil samples due to high matrix spike recoveries.

J⁶ - Estimate (J) all positive results for thallium, arsenic and mercury, and estimate (UJ) all negative results for thallium

due to low soil matrix spike recoveries.

J⁷ - Estimate (J) positive results and (UJ) non-detects for mercury in all water samples matrix spike recovery outside of criteria.

 \mathbb{R}^1 - Estimate (J) positive results and reject (R) non-detects due

to VOA surrogates diluted out.

R² - Reject (R) non-detects for arsenic and mercury in all soil samples due to low matrix spike recoveries.

HULMAN DATA VALIDATION RESULTS SUMMARY

Case No. RFW9010L572

7 Aqueous: MW0-01-FD-81-0.0-0.0, MW0-02-FT-82-0.0-0.0, MW0-01-T1-79-0.0-0.0, MWA-08-NS-77-0.0-0.0, MWB-01-E1-78-0.0-0.0, MWB-01-NS-70-0.0-0.0, MW2-04-NS-73-0.0-0.0

A validation was performed on the organic and inorganic analytical data from Case No. RFW#9010L572 low level aqueous samples collected by M&E at the Hulman Municipal Airport site. The data was evaluated based on the following parameters:

- * . data completeness
- * . holding times
- * . GC/MS Tuning
- * . calibration
 - blanks
- * . blank/spike control samples
- * . blank/spike laboratory control samples
- * . surrogate recoveries
 - . matrix spike/matrix spike duplicate
 - . pesticide instrument (GC) performance
- * All criteria were met for this parameter.

Table I summarizes the validation recommendations which were based on the following information:

ORGANICS

Blanks:

The pesticide/PCB, and TPH blanks contained no contaminants. The worst-case volatile and semivolatile TPH lab, equipment and trip blanks are summarized below:

	Compound	Max. Conc.	Action Level
Low Level	l: Methylene Chloride	17 ug/l	170 ug/l
	Acetone	14 ug/l	140 ug/l
	Chloroform	2J ug/l	10 ug/l
	Bis(2-ethylhexyl)phthala	ate 1 ug/l	10 ug/l

Blank Actions:

- . value < action level; report value followed by a UJ
- . value > action level; report value unqualified

The action levels were compared to sample values and the appropriate data qualifications were made.

Matrix Spike / Matrix Spike Duplicate:

No SVOA MS/MSD was reported for this case. The VOA MS/MSD met all QC criteria. Gamma-BHC had a slightly high percent recovery for the pesticide/PCB fraction, however no action was necessary since there were no positive results.

Pesticide Instrument (GC) Performance:

A number of compounds were slightly outside their retention time windows. The peaks were checked for each of the four samples (FD-81, FT-82, NS-77, and E1-78) which seemed questionable. Professional judgement deemed that none of the four samples need be qualified.

INORGANICS

All criteria were met for holding times, calibration, lab control sample (LCS) and LCS duplicate spike for all samples.

Blanks:

Antimony, calcium, sodium, nickel, vanadium, and zinc contamination was found in the equipment blank and in the calibration and/or prep blanks associated with these samples. The action levels for these analytes were as follows:

Sb 225 ug/l Ca 2080 ug/l Ni 149 ug/l Na 2875 ug/l V 95 ug/l Zn 91.5 ug/l

All positive results for these compounds which were less than the action level were qualified as estimated (UJ) due to blank contamination.

Matrix Spike / Matrix Spike Duplicate:

Soil matrix spike recoveries were low for arsenic, lead, selenium, silver, antimony, and thallium. Positive results (J) and non-detects (UJ) for these compounds were flagged as estimated. The non-detects for lead were not flagged as estimated, but were rejected (R) because its percent recovery was much less than 30%.

Hulman Field RFW # 9010L572

TABLE I. RECOMMENDATIONS SUMMARY

SAMPLE ID#	VOA	SVOA	PEST/PCB	METALS	TPH
MW0-01-FD-81-0.0-0.0 MW0-02-FT-82-0.0-0.0 MWA-08-NS-77-0.0-0.0 MWB-01-NS-70-0.0-0.0 MWB-01-E1-78-0.0-0.0	A ² A ² A ² A ² A ²	A ² A ² A ² A ² A ²	PEST/PCB A A A A A	METALS A ³ , J ¹ , R ¹ J ¹ , R ¹ J ¹ , R ¹ A ³ , J ¹ , J ² A ³ , J ¹	A A A A
MW2-04-NS-73-0.0-0.0 MW0-01-T1-79-0.0-0.0	$egin{array}{c} A^2 \ A^1 \end{array}$	A ²			A

A - Accept all data.

A¹ - Accept data but flag as estimated (UJ) all positive values for methylene chloride and acetone less than the action level due to blank contamination.

A² - Accept data but flag as estimated (UJ) all positive values for methylene chloride, acetone, chloroform, and bis(2-ethylhexyl)phthalate less than the action level due to blank contamination.

A³ - Accept data but flag as estimated (UJ) all positive values for nickel, vanadium, zinc, antimony, calcium and sodium less than the action level due to blank contamination.

 J^1 - Qualify as estimated (J) positive results and all (UJ) all non-detects for antimony, arsenic, selenium, silver and thallium due to low matrix spike recoveries.

 J^2 - Estimate (J) positive results for lead due to low MS/MS recovery.

R¹ - Reject (R) non-detects for lead due to very low (<30%) matrix spike recoveries.

^{-- -} Sample was not analyzed for this parameter.

HULMAN DATA VALIDATION RESULTS SUMMARY

Case No. RFW9010L576

4 Soils: SEB-01-NS-91-0.0-0.0, SE1-04-NS-94-0.0-0.0

SE1-05-NS-95-0.0-0.0, SE4-03-NS-93-0.0-0.0

7 Aqueous: SE0-01-T1-98-0.0-0.0, SEB-01-E1-96-0.0-0.0

SWB-01-E1-99-0.0-0.0, SEB-01-E1-96-0.0-0.0

SW1-04-NS-86-0.0-0.0, SW1-05-NS-87-0.0-0.0,

SW4-03-NS-85-0.0-0.0

A validation was performed on the organic and inorganic analytical data from Case No. RFW#9010L576 low level soil and low level aqueous samples collected by M&E at the Hulman Municipal Airport site. The data was evaluated based on the following parameters:

data completeness

- holding times
- GC/MS Tuning
- calibration
 - blanks
 - blank/spike control samples
- blank/spike laboratory control samples
 - surrogate recoveries
 - matrix spike/matrix spike duplicate
 - pesticide instrument (GC) performance
- * All criteria were met for this parameter.

Table I summarizes the validation recommendations which were based on the following information:

ORGANICS

Holding Times:

Holding time criteria were met for the VOA and the TPH extractions and analyses. The SVOA and pesticide/PCB samples were all extracted within the required holding time, but three of the pesticide samples were analyzed eight days over the required holding time. Results for these samples will be flagged as estimated: J for poitives, UJ for non-detects.

Blanks:

The pesticide/PCB blanks contained no contaminants. The worst-case volatile, semivolatile, and TPH lab, equipment and trip blanks are summarized below:

Compound	Max. Conc.	Action Level	
Low Level:			
Methylene Chloride	19 ug/kg	190 ug/kg (ug/l)	

Acetone	21 ug/kg	150 ug/kg (ug/l)
Chloroform	1J ug/l	5 ug/l (ug/kg)
Chloromethane	2J ug/kg	10 ug/kg
Di-n-butylphthalate	66J ug/kg	660 ug/kg
Bis(2-ethylhexyl)phtha	alate 59J ug/kg	590 ug/kg
ТРН	2.5 mg/kg	12.5 mg/kg

Blank Actions:

- . value < action level; report value followed by a UJ
- . value > action level; report value unqualified

The action levels were compared to sample values and the appropriate data qualifications were made.

Blank/Spike Control Sample (BS/BSD):

The VOA and SVOA BS/BSD recoveries met QC criteria. The aqueous SVOA had low recoveries for 1,4-dichlorobenzene (27%, 30%) and for 1,2,4-trichlorobenzene (34%,35%) while the aqueous pesticide fraction showed a high recovery for gamma-BHC (140). For the soil matrix BS/BSD, the VOA and SVOA recoveries were within QC criteria. The pesticide/PCB fraction showed a high recovery for dieldrin (152), low recovery for heptachlor (25), and interference with the recovery of gamma-BHC.

Positive results for these compounds will be flagged as estimated.

Surrogate Recoveries:

The surrogates which did not meet QC criteria are summarized below:

TR#s	VOA	PEST
	TOL	DBC
MW1-06-NS-75		189
SE6-02-NS-92	139	Diluted
		out

Any positive VOA results for the above soil sample will be flagged (J) as estimated, and all positive pesticide results (soil and water) will be flagged (J) as estimated. Non-detected results will be rejected (R) for the soil pesticide fraction.

Matrix Spike / Matrix Spike Duplicate:

The volatile and pesticide/PCB matrix spike recoveries were within the specified criteria. 4-Nitrophenol and 2,4-dinitrotoluene had slightly high recoveries in the semivolatile fraction. No action

was necessary since there were no positive values for these compounds.

Pesticide Instrument (GC) Performance:

Retention time windows were outside of criteria for a number of compounds, however, the only sample chromatogram affected was that for MW6-03-NS-72. This sample was not qualified based on RT windows, but rather on the surrogate recovery which was diluted out by a 50x dilution. Other minor problems were noted during the pesticides data review, but no data qualifications resulted from these.

INORGANICS

All criteria were met for holding times, calibration, lab control sample (LCS) and LCS duplicate spike for all samples.

Blanks:

Antimony, sodium and vanadium contamination was found in the water blank and sodium contamination was observed in the soil blank. Blank actions were necessary and were taken only for vanadium in the water samples. All vanadium hits less than 75 ug/l for the water samples were qualified as estimated due to blank contamination.

Matrix Spike / Matrix Spike Duplicate:

Soil matrix spike recoveries were low for arsenic, lead, and selenium and were high for zinc. No action was necessary for lead since the unspiked sample concentration exceeded the spiked sample concentration by more than four times the amount. Positive results for arsenic, selenium and zinc were flagged (J) as estimated, and non-detects for arsenic and selenium were rejected (R) since their MS/MSD recoveries were below 30%.

Water MS/MSD recoveries were high for aluminum, iron, lead and mercury and were low for antimony, arsenic, selenium, silver, and thallium. Positive results for all of these compounds except Al and Fe (which required no action) were flagged (J) as estimated. Non-detects for Sb, As, Se, and Tl were flagged (UJ) as estimated.

Hulman Field RFW # 9010L576

TABLE I. RECOMMENDATIONS SUMMARY

SAMPLE ID#	VOA	SVOA	PEST/PCB	METALS	TPH
SEB-01-NS-91-0.0-0.0 SE1-04-NS-94-0.0-0.0 SE1-05-NS-95-0.0-0.0 SE4-03-NS-93-0.0-0.0 SWB-01-NS-83-0.0-0.0 SW1-04-NS-86-0.0-0.0 SW1-05-NS-87-0.0-0.0	A ⁴ A ⁴ A ⁴ A ³ A ³ A ³	A ⁴ A ⁴ A ⁴ A ⁴ A ³ A ³ A ³	A J ¹ , J ³ , J ⁴ J ¹ , J ⁴ A J ² A	A ⁶ , J ⁵ , R ¹ A ⁶ , J ⁵ A ⁶ , J ⁵ J ⁵ , J ⁶ J ⁵ , R ¹ J ⁵ , R ¹	A ⁵ A ⁵ A ⁵ A ⁵ A A A
SW1-05-NS-87-0.0-0.0 SW4-03-NS-85-0.0-0.0 SWB-01-E1-99-0.0-0.0 SWB-01-E1-99-0.0-0.0 SEB-01-E1-96-0.0-0.0 SE0-01-T1-98-0.0-0.0	A ³ A ² A ² A ¹	A ³ A ² J ¹ A ²	J ¹	J ⁷ , J ⁸	A A A

- A Accept all data.
- A' Accept data but flag as estimated (UJ) all positive values for methylene chloride and acetone less than the action level due to blank contamination.
- A² Accept data but flag as estimated (UJ) all positive values for methylene chloride, acetone, and bis(2-ethylhexyl)phthalate less than the action level due to blank contamination.
- A³ Accept data but flag as estimated (UJ) all positive values for methylene chloride, acetone, chloroform, chloromethane, and bis(2-ethylhexyl)phthalate less than the action level due to blank contamination.
- A⁴ Accept data but flag as estimated (UJ) all positive values for methylene chloride, acetone, chloroform, di-n-butylphthalate and bis(2-ethylhexyl)phthalate less than the action level due to blank contamination.
- A⁵ Accept data but flag as estimated (UJ) all positive values for TPH less than 12.5 mg/kg due to blank contamination.
- A⁶ Accept data but flag as estimated (UJ) positive results for nickel and vanadium less than the action level due to blank contamination.
- J^{1} Qualify as estimated (J) positive results and (UJ) non-detects due to analyses holding times exceeded.
- J^2 Estimate (J) positive results for gamma-BHC due to high water MS/MSD recovery.
- J³ Estimate (J) positive results for endrin, dieldrin, aldrin, and gamma BHC due to high soil MS/MSD recoveries.
- J⁴ Estimated (J) all positive results for lindane due to high blank spike recovery.
- J^5 Estimate (J) all positive results and (UJ) all non-detects for

silver, arsenic, antimony, selenium, and thallium due to low matrix spike recoveries.

J⁶ - Estimate (J) positive values for lead due to low matrix spike

recovery.

- R1 Reject (R) non-detects for lead in the water samples due to very low (<30%) matrix spike recoveries.
 -- Sample was not analyzed for this parameter.

HULMAN DATA VALIDATION RESULTS SUMMARY

Case No. RFW9010L600

1 Soil: SE6-02-NS-92-0.0-0.0

7 Aqueous: MW5-02-NS-71-0.0-0.0, MW6-03-NS-72-0.0-0.0,

MW4-05-NS-74-0.0-0.0, MW1-06-NS-75-0.0-0.0,

MW5-07-NS-76-0.0-0.0, MW0-02-T2-80-0.0-0.0,

MW0-03-NS-92-0.0-0.0

A validation was performed on the organic and inorganic analytical data from Case No. RFW#9010L600 low level soil and low level aqueous samples collected by M&E at the Hulman Municipal Airport site. The data was evaluated based on the following parameters:

- * . data completeness
- * . holding times
- * . GC/MS Tuning
- * . calibration
 - . blanks
 - blank/spike control samples
- * . blank/spike laboratory control samples
 - surrogate recoveries
 - . matrix spike/matrix spike duplicate
 - pesticide instrument (GC) performance
- * All criteria were met for this parameter.

Table I summarizes the validation recommendations which were based on the following information:

ORGANICS

Blanks:

The pesticide/PCB blanks contained no contaminants. The worst-case volatile, semivolatile and TPH lab, equipment and trip blanks are summarized below:

Compound		Max. Conc.	Action Level	
Low Level	: Methylene Chloride	15 ug/kg	150 ug/kg (ug/l)	
	Acetone	15 ug/l	150 ug/kg (ug/l)	
	Chloroform	2J ug/l	10 ug/l	
	4-Methyl-2-pentanone	2J ug/l	10 ug/l	
	2-Hexanone	3J ug/l	15 ug/l	

Di-n-butylphthalate	66J ug/kg	660 ug/kg
Bis(2-ethylhexyl)phth	alate 59J ug/kg	590 ug/kg
ТРН	2.5 mg/kg	12.5 mg/kg

Blank Actions:

- . value < action level; report value followed by a UJ
- value > action level; report value unqualified

The action levels were compared to sample values and the appropriate data qualifications were made.

Blank/Spike Control Sample (BS/BSD):

The VOA BS/BSD samples met QC criteria. The aqueous SVOA had low recoveries for 1,4-dichlorobenzene (27%, 30%) and for 1,2,4-trichlorobenzene (34%,35%) while the aqueous pesticide fraction showed a high recovery for gamma-BHC (140). For the soil matrix BS/BSD, the VOA and SVOA recoveries were within QC criteria. The pesticide/PCB fraction showed a high recovery for dieldrin (152), low recovery for heptachlor (25), and interference with the recovery of gamma-BHC.

Positive results for these compounds will be flagged as estimated.

Surrogate Recoveries:

The surrogates which did not meet QC criteria are summarized below:

TR#s	<u>VOA</u>	PEST
	TOL	DBC
MW1-06-NS-75		189
SE6-02-NS-92	139	Diluted
		out

Any positive VOA results for the above soil sample will be flagged (J) as estimated, and all positive pesticide results (soil and water) will be flagged (J) as estimated. Non-detected results will be rejected (R) for the soil pesticide fraction.

Matrix Spike / Matrix Spike Duplicate:

The volatile and pesticide/PCB matrix spike recoveries were within the specified criteria. 4-Nitrophenol and 2,4-dinitrotoluene had slightly high recoveries in the semivolatile fraction. No action was necessary since there were no positive values for these compounds.

Pesticide Instrument (GC) Performance:

Retention time windows were outside of criteria for a number of compounds, however, the only sample chromatogram affected was that for MW6-03-NS-72. This sample was not qualified based on RT windows, but rather on the surrogate recovery which was diluted out by a 50x dilution. Other minor problems were noted during the pesticides data review, but no data qualifications resulted from these.

INORGANICS

All criteria were met for holding times, calibration, lab control sample (LCS) and LCS duplicate spike for all samples.

Blanks:

Antimony, sodium and vanadium contamination was found in the water blank and sodium contamination was observed in the soil blank. Blank actions were necessary and were taken only for vanadium in the water samples. All vanadium hits less than 75 ug/l for the water samples were qualified as estimated due to blank contamination.

Matrix Spike / Matrix Spike Duplicate:

Soil matrix spike recoveries were low for arsenic, lead, and selenium and were high for zinc. No action was necessary for lead since the unspiked sample concentration exceeded the spiked sample concentration by more than four times the amount. Positive results for arsenic, selenium and zinc were flagged (J) as estimated, and non-detects for arsenic and selenium were rejected (R) since their MS/MSD recoveries were below 30%.

Water MS/MSD recoveries were high for aluminum, iron, lead and mercury and were low for antimony, arsenic, selenium, silver, and thallium. Positive results for all of these compounds except Al and Fe (which required no action) were flagged (J) as estimated. Non-detects for Sb, As, Se, and Tl were flagged (UJ) as estimated.

Hulman Field RFW # 9010L600

TABLE I. RECOMMENDATIONS SUMMARY

SAMPLE ID#	VOA	SVOA	PEST/PCB	METALS	TPH
SE6-02-NS-92-0.0-0.0	A^3, J^1	A^3	J^2,J^6	J^9 , R^1	A^4
MW6-03-NS-72-0.0-0.0	A^2	J⁴,J⁵	A	\mathtt{J}^7 , \mathtt{J}^8	A
MW4-05-NS-74-0.0-0.0	A^2	J⁵			A
MW1-06-NS-75-0.0-0.0	A^2	J⁵	\mathtt{J}^3	J ⁷ , J ⁸	A
MW5-02-NS-71-0.0-0.0	A^2	J ⁵		\mathbf{A}_{2}^{5} , \mathbf{J}_{3}^{7} , \mathbf{J}_{3}^{8}	A
MW5-07-NS-76-0.0-0.0	A^2	J⁵	A	\mathbf{J}^7 , \mathbf{J}^8	A
MW0-02-T2-80-0.0-0.0	A^1				
MW0-03-T3-90-0.0-0.0	A^1				

- A Accept all data.
- A¹ Accept data but flag as estimated (UJ) all positive values for methylene chloride and acetone less than the action level due to blank contamination.
- A² Accept data but flag as estimated (UJ) all positive values for methylene chloride, acetone, and chloroform less than the action level due to blank contamination.
- A³ Accept data but flag as estimated (UJ) all positive values for methylene chloride, acetone, chloroform, 2-hexanone, and 4-methyl-2-pentanone less than the action level due to blank contamination.
- A⁴ Accept data but flag as estimated (UJ) all positive values for TPH less than 12.5 mg/kg due to blank contamination.
- A⁵ Accept data but flag as estimated (UJ) positive results for vanadium less than 75 ug/l for all water samples due to blank contamination.
- J¹ Qualify as estimated (J) positive results for SE6-02-NS-92-0-0 due to the surrogate compound toluene exceeding QC limits.
- J² Estimate (J) positive results and reject (R) non-detects for all compounds due to the surrogate compound dibutylchlorendate (DBC) being diluted out.
- J^3 Estimate (J) positive results due to high DBC recovery.
- J⁴ Qualify as estimated (J) all positive results for 4nitrophenol and 2,4-dinitrotoluene due to high matrix spike recoveries.
- J₅ Estimate (J) positive values for 1,2,4-trichlorobenzene and 1,4-dichlorobenzene due to low blank spike recoveries.
- J₆ Estimate (J) positive values and reject (R) non-detects for gamma-BHC to low blank spike recoveries.
- J⁷ Estimate (J) all positive results and (UJ) all non-detects for silver, arsenic, antimony, selenium, and thallium due to low matrix spike recoveries.
- J⁸ Estimate (J) positive values for lead and mercury due to high matrix spike recoveries.
- J^9 Qualify as estimated (J) all positive results for arsenic,

selenium and zinc in soil due to matrix spike recoveries outside of criteria.

R¹ - Reject (R) non-detects for arsenic and selenium in soil due to very low (<30%) matrix spike recoveries.</p>

-- - Sample was not analyzed for this parameter.

March 30, 1992

Mr. Richard Westmoreland Hazardous Waste Remedial Action Program Martin Marietta P.O. Box 2009, FEDC Building Oak Ridge, Tennessee 37831

Re: Contract No. 43B-99791C

Weston Analytical Laboratory

Hulman ANG

TPH: 6 soils/SS6-16-NS-111-0.0-05 to SS6-21-NS-116-0.0-0.5 Volatiles: 6 soils/SS6-16-NS-111-0.0-05 to SS6-21-NS-116-0.0-0.5 Semivolatiles: 6 soils/SS6-16-NS-111-0.0-05 to SS6-21-NS-116-0.0-0.5

Pesticide/PCBs: 6 soils/SS6-16-NS-111-0.0-05 to SS6-21-NS-116-0.0-0.5

Dear Mr. Westmoreland:

A validation was performed on the organic analytical data from Case No. RFW #9201L056 soil samples collected by Metcalf & Eddy at the Hulman ANG site. The data was evaluated based on the following parameters:

- * data completeness
 - holding times
- C/MS tuning
 - calibration
 - blanks
 - blank spike/laboratory control sample
 - surrogate recoveries
 - matrix spike/matrix spike duplicate
- internal standard performance
- * pesticide instrument performance
- compound identification
- * compound quantitation
- * All criteria were met for this parameter.

Table I summarizes the validation recommendations which were based on the following information:

Holding Times:

The samples for TPH, volatile and pesticide/PCB analysis were all extracted and analyzed within the required holding time.

The samples for semivolatile analysis were initially extracted within the required holding time. However, during gel-permeation cleanup, the samples were lost due to a gel-permeation malfunction. Reserve portions of the extracts (prior to gel permeation) were diluted two-fold, analyzed and reported.

All of the samples for semivolatile analysis were reextracted seven days over the required holding time limit of fourteen days, while the analyses were performed within the required holding time. Only the results of the reextracted samples were validated and used flagging all positive results as estimated (J) and all non-detects as estimated (UJ).

Calibration:

A number of compounds did not meet the specified criteria for the initial calibrations and the continuing calibrations for both volatile and semivolatile analyses. These are listed in the tables which follow.

A five-point standard curve was performed daily, and all correlation coefficients were 0.995 for the TPH analyses. In addition, pesticide/PCB continuing calibrations were out of criteria for aldrin, alpha-BHC, and gamma-BHC. Corresponding sample values are estimated (J) for positive values.

Volatile Calibration

Instrument 1050W

Compound	IC 1/ 29/ 92	CC 1/30/92
Acetone	X	
Chloromethane	X	
4-Methyl, 2-pentanone		X
2-Hexanone		X
1,1,2,2-Tetrachloroethane		X
Samples Affected	All Samples	All Samples

Semivolatile Calibration

Instrument 5100SP

Compound	CC 2/10/92	CC 2/11/92	
2,2'-Oxybis(2-chloropropane)	X		
Pyrene		X	
2,4-Dimethylphenol		X	
2-Nitroaniline		X	
4-Nitrophenol		X	
Butylbenzylphthalate		X	
bis(2-ethylhexyl)phthalate		X	
Associated Samples	SS6-20	S6-16-NS-111-0.0-0.5RE D-NS-115-0.0-0.5RE (MS/MS) S6-21-NS-116-0.0-0.5RE	D)

X - Percent RSD >30, Percent D >25; Estimate (J) all positive results.

Note: Data was flagged according to the above HAZWRAP criteria; however, note that all of the listed compounds except pyrene, 2,4-dimethylphenol and 1,1,2,2-tetrachloroethane no longer have a maximum %RSD or %D according to the 3/90 SOW.

Blanks:

The TPH and pesticide/PCB blanks contained no contaminants. The semivolatile and volatile blanks are summarized in the following table which shows the maximum concentration for any of the method, trip, or equipment blanks:

Compound	Maximum Concentration (ug/l)	Action Level (ug/kg)
Methylene Chloride	5J	50
Acetone	10	100
Chloroform	2J	10
Di-n-butylphthalate	2J	660
Bis(2-ethylhexyl)phthalate	4J	1320

^{+ -} RF, RF <0.05; Estimate (J) all positive results and reject (R) all non detects.

Blank Actions:

Value < CRQL; report CRQL followed by a U

Value > CRQL and < action level; report value followed by a U

Value > CRQL and > action level; report value unqualified

The action levels were compared to sample values and the appropriate data qualifications were made.

Blank Spike/Laboratory Control Sample:

No laboratory control sample (LCS) was analyzed for the TPH or the volatile fractions. The recovery for phenol (98%) in the semivolatile fraction was slightly greater than the upper QC limit of 90%. No actions were taken based on LCS results.

Surrogate Recoveries:

The surrogates which did not meet criteria are summarized below:

	Percent Recoveries VOA
TR Nos.	BFB
SS6-16-NS-111-0.0-0.5RE	124

Weston, in their case narrative, reported that 21 of the soil surrogate recoveries for the semivolatile fraction were outside of QC limits. Re-analyis of the re-extracted, gel-permeated samples showed successful surrogate recoveries for all compounds. The following flags will be applied to the sample data for each sample outside of the Contract Required Recovery Range (CRR):

	Percent Recovery		
	<10%	10% - CRR	>CRR
Positive Sample Results	J	J	J
Non-detected Results	R	UJ	UJ

Matrix Spike and Matrix Spike Duplicates:

The recoveries of the Matrix Spike/Matrix Spike Duplicates (MS/MSD) for the volatiles and the pesticides/PCBs were within the Contract Required Recovery Range.

In the semivolatile fraction, the relative percent difference for pyrene was high. Recoveries for 4-nitrophenol, 2,4-dinitrotoluene and 4-chloro-3-methylphenol were also higher than the CRR. Pyrene was detected in the unspiked sample and flagged as indicated below.

The following actions will be applied to the unspiked sample data:

 If any compound does not meet the Contract Required Recovery Range (CRR), the data will be flagged as stated below:

		Percent Recovery	
	<10%	10% - CRR	>CRR
	/		
Positive Sample Results	J	J	J
Non-detected Results	R	Α	Α

Field Duplicates:

Samples SS6-17-NS-112-0.0-0.5 and SS6-21-NS-116-0.0-0.5 were the reported field duplicates. HAZWRAP Level C criteria does not require that any action be taken based on field duplicates.

Internal Standard Performance:

Internal standard area counts were outside of the acceptable range for 1,4-difluoro-benzene (IS2) and chlorobenzene-d₅ (IS3) in the volatile fraction, and for chrysene-d₁₂ (IS5) and perylene-d₁₂ (IS6) in the semivolatile fraction. No action was necessary for the semivolatile fraction since only blanks were analyzed following these standards. Qualification of the volatile data consisted of flagging positive results as estimated (J) and flagging negative results as estimated (UJ) for the compounds that were quantified using IS2 and IS3.

Sincerely,

METCALF & EDDY, INC.

Jonna Straker

Donna Straker Reviewer

DATA SUMMARY KEY

- A Acceptable data.
- ${\tt J}\,$ The associated numerical value is an estimated quantity.
- R Reject data due to quality control criteria. The data are unusable (compound may or may not be present). Resampling and reanalysis is necessary for verification.
- U The compound was analyzed for but was not detected. The associated numerical value is the sample quantitation limit.
- UJ The compound was analyzed for but was not detected. The sample quantitation limit is an estimated quantity.

Hulman ANG Site Case No. RFW#9201L056

TABLE I. RECOMMENDATIONS SUMMARY

TR Nos.	VOA	SVOA	Pesticide/PCB	TPH
SS6-16-NS-111-0.0-0.5 SS6-16-NS-111-0.0-0.5RE	A ¹ ,A ³	A ³ ,J ¹	Α	Α
SS6-17-NS-112-0.0-0.5 SS6-17-NS-112-0.0-0.5RE	A ¹ ,A ³	A ³ ,J ¹	Α	Α
SS6-18-NS-113-0.0-0.5 SS6-18-NS-113-0.0-0.5RE	A ¹ ,A ³	A^3 , J^1	Α	Α
SS6-19-NS-114-0.0-0.5 SS6-19-NS-114-0.0-0.5RE	A^{1}, A^{2}, A^{3}	A ³ ,J ¹	Α	Α
SS6-20-NS-115-0.0-0.5 SS6-20-NS-115-0.0-0.5RE	A^1,A^2	A ³ ,J ¹	Α	Α
SS6-21-NS-116-0.0-0.5 SS6-21-NS-116-0.0-0.5RE	A ¹ ,A ³	۸ ³ ,յ ^۱	Α	A

A - Accept all data.

- A¹ Accept data but estimate (J) positive results for acetone, chloromethane, 2-hexanone, 4-methyl-2-pentanone, and 1,1,2,2-tetrachloroethane due to calibration QC limits being out of range.
- A² Accept data but flag as non-detect (U) all positive values for acetone, chloroform, methylene chloride and bis(2-ethylhexyl)phthalate at concentrations greater than the CRQL but less than the action level (210 and 2100 ug/kg, respectively) due to blank contamination.
- A³ Accept data, report CRQL, and flag as non-detect (U) all positive values for acetone, chloroform, methyl chloride, di-n-butylethalate, and bis(2-ethylhexyl)phthalate detected at concentrations less than the CRQL due to blank contamination.
- J^{1} Estimate (UJ) all non-detects and (J) all detects due to exceeded holding times.

HULMAN DATA VALIDATION RESULTS SUMMARY

INORGANICS

Case No. RFW9201L056

6 Soils: SS6-16-NS-111-0.0-0.5, SS6-17-NS-112-0.0-0.5, SS6-18-NS-113-0.0-0.5, SS6-19-NS-114-0.0-0.5, SS6-20-NS-115-0.0-0.5, SS6-21-NS-116-0.0-0.5,

A validation was performed on the inorganic analytical data from Case No. RFW#9201L056 soil samples collected by M&E at the Hulman Municipal Airport site. The data was evaluated based on the following parameters:

- * . data completeness
- holding times
- * . calibration
 - . blanks
- blank/spike laboratory control samples
 - matrix spike/matrix spike duplicate
- * All criteria were met for this parameter.

Table I summarizes the validation recommendations which were based on the following information:

All criteria were met for holding times, calibration, lab control sample (LCS) and LCS duplicate spike for all samples.

Blanks:

No contaminants were found in any of the equipment blanks associated with these samples. Antimony, thallium, vanadium, zinc, iron, and magnesium contamination was found in the calibration and/or prep blanks associated with these samples. Results for soil samples which contained these analytes at concentrations greater than the IDL, but less than the action level were qualified as estimated (J). The action levels for these analytes were as follows:

Antimony	28.5	mg/kg
Thallium	2.3	mg/kg
Vanadium	7.0	mg/kg
Zinc	4.4	mg/kg
Iron	90.1	mg/kg
Magnesium	113.0	mg/kg

Matrix Spike / Matrix Spike Duplicate:

Matrix spike recoveries for antimony, arsenic, lead, and selenium were outside of criteria. Positive values for these analytes were estimated (J) and non-detects (UJ) were also estimated. For arsenic non-detects will be rejected (R), due to extremely low recovery and the possibility that false negatives exist.

Hulman Field RFW # 9201L056

TABLE I. RECOMMENDATIONS SUMMARY

SAMPLE ID#	METALS
SS6-16-NS-111-0.0-0.5	A^1
SS6-17-NS-112-0.0-0.5	${f A}^1$
SS6-18-NS-113-0.0-0.5	${\mathtt A}^1$
SS6-19-NS-114-0.0-0.5	$\mathbf{A}^{\mathbf{I}}$
SS6-20-NS-115-0.0-0.5	\mathbf{A}^{1}
SS6-21-NS-116-0.0-0.5	\mathbf{A}^{1}

A¹ - Estimate (J) positive results for antimony, arsenic, lead and selenium and estimate (UJ) non-detects for antimony, lead, and selenium due to MS/MSD recoveries out of criteria.

HULMAN DATA VALIDATION RESULTS SUMMARY

Case Nos. RFW9201L030, L056, L068, L073

17 Aqueous: MWO-01-FD-140-0.0-0.0, MWO-02-FT-141-0.0-0.0, MWA-08-NS-108-0.0-0.0, MW2-04-NS-104-0.0-0.0, MW6-03-NS-103-0.0-0.0, MW6-07-NS-107-0.0-0.0 PZ4-01-NS-109-0.0-0.0, PZ4-01-NS-109-0.0-0.0, MW1-06-NX-106-0.0-0.0 MWB-01-E1-133-0.0-0.0, MW1-06-E2-134-0.0-0.0, MW0-01-T1-117-0.0-0.0, MW0-02-T2-118-0.0-0.0, MW0-03-T3-119-0.0-0.0, MW0-04-T4-120-0.0-0.0, SS6-16-E2-134-0.0-0.0

A validation was performed on the organic and inorganic analytical data from Case Nos. RFW#9201L030, RFW#9201L056, RFW#9201L068, and RFW#9201L073, low level aqueous samples collected by M&E at the Hulman Municipal Airport site. The validation summaries for these cases were combined because the media is all water and the same QC results (MS/MSD, blanks, and initial calibrations) apply to these samples. The data was evaluated based on the following parameters:

- * . data completeness
- * . holding times
- * . GC/MS Tuning
 - . calibration
 - blanks
 - blank/spike laboratory control samples
 - surrogate recoveries
 - . matrix spike/matrix spike duplicate
- * . pesticide instrument (GC) performance
- * . compound identification
- compound quantitation
- * All criteria were met for this parameter.

<u>Table I summarizes the validation recommendations which were based on the following information:</u>

ORGANICS

Calibration:

A number of compounds did not meet the specified criteria for the initial calibrations an the continuing calibrations for both the volatile and the semivolatile analyses. These are listed in the tables which follow.

A five-point standard curve was performed daily, and all correlation coefficients were 0.995 for the TPH analysis. In addition, pesticide/PCB continuing calibrations were out of criteria for alpha-BHC, and gamma-BHC. Corresdponding sample

values are estimated (J) for positive values and (UJ) for non-detects.

Volatile Calibration

Instrument 1050Q

Ä	IC	СС	CC	СС	cc
Compound	1/10/92	1/20/92	1/17/92 1/27/92 1/29/92	1/28/92	1/31/92
2-Butanone	+	+	+	+	+
Carbon tetrachlori Chloroethane	ide	X		x	X
Bromoform					X
Associated Samples	All Samp	les			

Semivolatile Calibration

Instrument 5100SP

	CC	CC	CC	CC
Compound	1/31/92	2/1/92	2/3/92	2/4/92
2,2'-Oxybis(2-chloropropane)		х	x	Х
Isophorone		X	X	
Bis(2-chloroethoxy)methane			X	
Hexachlorocyclopentadiene	X		X	X
Carbazole		X	X	X
N-nitroso-di-n-propylamine				X
3-Nitroaniline	X	X	X	
Di-n-butylphthalate				X
3,3-Dichlorobenzidine	X	X		
Phenol		X		
2-Chlorophenol	,	X		

X - Percent RSD>30, Percent D>25; Estimate (J) all positive results

Note: Data was flagged according to the above Hazwrap criteria: however, note that all of the listed compounds except carbon tetrachloride, bromoform, bis(2-chloroethoxy)methane, and isophorone no longer have a maximum %RSD or %D according to the 3/90 SOW.

^{+ -} RF, RF <0.05; Estimate (J) all positive results and reject (R) all non-detects.

Blanks:

The pesticide/PCB, and TPH blanks contained no contaminants. The worst-case volatile and semivolatile lab, equipment and trip blanks are summarized below:

	Compound	Max. Conc.	Action Level
Low Level	: Methylene Chloride	4J ug/l	40 ug/l
	Acetone	10 ug/l	100 ug/l
	Chloroform	5J ug/l	25 ug/l
	Bis(2-ethylhexyl)phthala	te 3 ug/l	30 ug/l
	Diethylphthalate	4J ug/l	40 ug/l
	Di-n-butylphthalate	4J ug/l	40 ug/l

Blank Actions:

- . value < CRQL; report CRQL followed by a U
- . value > CRQL and < action level; report value followed by a U
- . value > CRQL and > action level; report value unqualified

The action levels were compared to sample values and the appropriate data qualifications were made.

Blank Spike / Laboratory Control Sample:

No laboratory control sample (LCS) was analyzed for the TPH or the volatile fractions. Recoveries for 4-chloro-3-methylphenol and 4-nitrophenol were slightly higher than the QC limit. No actions were taken based on LCS results.

Surrogate Recoveries:

One acid surrogate spike (phenol-d5) for the SVOA fraction showed a low recovery (3%) for sample MWO-O2-FT-141. No action was taken, since the lower advisory limit for this compound is 10% and the only sample affected was the tap water blank. Also, the MS/MSD analysis fulfilled its reanalysis requirement.

Surrogate recoveries for the pesticide/PCB fraction were outside acceptance criteria for the three equipment blanks and for samples MW6-03-NS-103, MW6-07-NS-107, and MW1-06-NX-106. Results for these samples will be estimated; (J) for positive values and (UJ) for non-detects.

Matrix Spike / Matrix Spike Duplicate:

The VOA MS/MSD met all QC criteria. Acenaphthene, 4-nitrophenol, pyrene, and 2,4-dinitrotoluene had high percent recoveries for the SVOA fraction and a couple of compounds for the pesticide/PCB fraction were also out of criteria. No action was taken with respect to MS/MSDs since there were no positive results for the associated SVOA samples and the pesticide/PCB results were previously flagged as estimated due to poor surrogate recoveries.

Internal Standard Performance:

A number of VOA and SVOA internal standards were outside of criteria. Reanalysis was done and produced similar results. No action was taken since the only samples analyzed following the out-of-control standards were blanks (one method blank and two field blanks, FD-140 and FT-141). The VOA standard applied only to the MSD sample.

Compound Quantitation:

The criteria stated in the 3/90 SOW were applied to duplicate injections with a %D greater than 25%. The lower value was reported as estimated (J) by the laboratory. No other actions were taken.

INORGANICS

All criteria were met for holding times, calibration, lab control sample (LCS) and LCS duplicate spike for all samples.

Blanks:

No contaminants were found in any of the equipment blanks associated with these samples. Antimony, thallium, vanadium, and zinc contamination was found in the calibration and/or prep blanks associated with the field QC samples and sample MWA-08-NS-108, while mercury and vanadium were found in those blanks associated with the other aqueous samples. The action levels for these analytes were as follows:

	Antimony	142.5	
	Thallium	11.5	ug/l
	Vanadium	35.0	ug/l
	Zinc	22.0	ug/l
and			
	Mercury	0.66	ug/l
	Vanadium	29.5	ug/l

All positive results for these compounds which were less than the action level were qualified as estimated (J) due to blank contamination.

Matrix Spike / Matrix Spike Duplicate:

Matrix spike recoveries were low for aluminum, arsenic, selenium, silver, and thallium. Positive results (J) and non-detects (UJ) for these compounds were flagged as estimated. The MS recovery was higher than 125% for iron, so positive results for this analyte were flagged as estimated (J) and non-detects were accepted unqualified. The percent recovery for aluminum was only 10% but they were no non-detects for aluminum and therefore no need to reject data. The matrix spike recovery for dissolved silver was less than 30% so non-detects for this compound will be rejected for the associated sample.

Hulman Field RFW # 9201L030, L056, L068, L073

TABLE I. RECOMMENDATIONS SUMMARY

SAMPLE ID#	VOA	SVOA	PEST/PCB	METALS	TPH
	_1	_ <	- 6	_	_
MWA-08-NS-108-0.0-0.0	\mathbb{R}^1	A ⁵	A_{\cdot}^{6}	A	A
MW6-03-NS-103-0.0-0.0	A^2, R^1	A	J¹	A^8, A^9	A
MW6-07-NS-107-0.0-0.0	A^2, R^1	A ⁵	\boldsymbol{J}^1	A°, A'	A
MW1-06-NX-106-0.0-0.0	A^3, R^1	A ⁵	${f J}^1$	A^8, A^9, R^2	A
MWB-01-E1-133-0.0-0.0	A^3, R^1	A ⁵	J¹ -	A	A
MW1-06-E2-134-0.0-0.0	\mathbb{R}^1	A ⁵	J ¹	A	A
SS6-16-E2-134-0.0-0.0	A^2, A^3, R^1	l A ⁵	J¹	A	A
PZ4-01-NS-109-0.0-0.0	\mathbb{R}^1	A ⁵			A
PZ4-01-NS-110-0.0-0.0	A^1, A^3, R^1				A
MW4-05-NX-105-0.0-0.0	A^3, R^1	A^5			A
MW2-04-NS-104-0.0-0.0	A^2, A^3, R^1	l A ⁵			A
MW0-01-T1-117-0.0-0.0	A^3, R^1				
MW0-02-T2-118-0.0-0.0	A^3, R^1				
MW0-03-T3-119-0.0-0.0	A^3, R^1				
MW0-04-T4-120-0.0-0.0	A^1, A^3, R^1	L			
MW0-01-FD-140-0.0-0.0	A^3, A^4, R^1	l A ⁵	A	A	A
MW0-02-FT-141-0.0-0.0	A^4 , R^1	A ⁵	A	A	A

- A Accept all data.
- A¹ Accept data but estimate (J) positive values for carbon tetrachloride and bromoform due to calibration being out of range.
- A^2 Accept data but estimate (J) positive values for chloroethane due to calibration being out of range.
- A³ Accept data, report CRQL, and flag as non-detect (U) all positive values for methylene chloride, acetone, and chloroform.
- A⁴ Accept data but flag as non-detect (U) positive values for chloroform due to blank contamination.
- A⁵ Accept data, report CRQL, and flag as non-detect (U) all positive values for bis(2-ethylhexyl)phthalate and di-n-butylphthalate less than the action level due to blank contamination.
- A⁶ Accept data but estimate (J) positive values and estimate (UJ) non-detects for alpha-BHC and gamma-BHC due to calibration being out of range.
- A⁷ Accept data but flag as estimated (J) positive values for zinc less than the action level due to blank contamination.
- A⁸ Accept data but flag as estimated (J) all positive values for vanadium and mercury less than the action level due to blank contamination.
- A⁹ Qualify as estimated (J) positive results and all (UJ) all non-detects for arsenic, selenium, silver and thallium due to

low matrix spike recoveries.

- A¹⁰ Estimate (J) positive results for aluminum and iron due to MS/MSD recoveries out of criteria.
- J¹ Qualify as estimated (J) all positive results and all nondetects (UJ) for the pesticide fraction due to low surrogate recoveries.
- R¹ Reject (R) non-detects and estimate (J) positive results for 2-butanone due to calibration being out of range.
- R² Reject (R) non-detects for soluble silver due to very low (<30%) matrix spike recoveries.
- -- Sample was not analyzed for this parameter.

DEVELOPMENT WATER ANALYTICAL DATA



2500 PRAIRIETON ROAD · P. O. BOX 959 · TERRE HAUTE, INDIANA 47808-0959

(812) 235-0838

TEST RESULTS =========

Report To: Ms. Deborah Simone Metcalf and Eddy, Inc. 10 Harvard Mill Square Wakefield, MA 01880

Date Received: 10/24/90 Date Complete: 11/05/90 COC #: 4420

Sample Description: Water Sample Date:

10/24/90

Sample ID:

MWB -01

TEST DESCRIPTION	RESULT	UNITS	METHOD	ANALYST	DATE
HALDGENATED VOLATILE ORGANICS					
Benzyl chloride	₹10	U6/L	S# 8010	TL	10/30/90
Bis(2-chloroethoxy)methane	₹10	UG/L	SW 8010	TL	10/30/90
Bis(2-chloroisopropyl)ether	₹10	UG/L	5₩ 8010	TL	10/30/90
Bromobenzene	<10	UG/L	SW 8010	TL	10/30/90
Bromodichloromethane	<10	U6/L	SW 8010	TL	10/30/90
Bronotorm	₹10	UG/L	SW 8010	TL	10/30/90
Bromomethane	₹10	UG/L	SW 8010	TL	10/30/90
Carbon tetrachloride	₹10	UG/L	SW 8010	TL	10/30/90
Chloroacetaldehyde	₹10	UG/L	5W 8010	TL	10/30/90
Chloropenzene	<10	UG/L	SW 8010	TL	10/30/90
Ehloroethane	₹10	U6/L	SW 8010	TL	10/30/90
Chloroform	13	UG/L	SW 8010	TL	10/30/90
1-Chlorohexane	₹10	U6/L	SW 8010	TL	10/30/90
2-Chloroethyl vinyl ether	₹10	UG/L	SW 8010	TL	10/30/90
Chloromethane	<10	US/L	SW 8010	TL	10/30/90
Chloromethylmethyl ether	₹10	UG/L	SW 8010	TL	10/30/90
Chlorotoluene	₹10	VG/L	SW 8010	TL	10/30/90
Dibromochioromethane	₹10	UG/L	SW 8010	TL	10/30/90
Dibromomethane	<10	US/L	SW 8010	TL	10/30/90
1.2-Dichlorobenzene	<10	U6/L	SW 8010	TL	10/30/90
1.3-Dichlorobenzene	<10	U6/L	SW 8010	TL	10/30/90
1.4-Dichlorobenzene	<10	UG/L	SN 8010	TL	10/30/90
Dichlorodifluoromethane	<10	U6/L	SW 8010	TL	10/30/90
1,1-Dichloroethane	<10	V6/L	SW 8010	TL	10/30/90
1.2-Dichloroethane	₹10	US/L	SW 8010	TL	10/30/90
1.1-Dichloroethylene	<10	UG/L	SW 8010	TL	10/30/90
trans-1.2-Dichloroethylene	₹10	U6/L	SW 8010	TL	10/30/90
Dichloromethane	₹10	VG/L	SW 8010	TL	10/30/90
1.2-Dichloropropane	₹10	UG/L	5W 8010	· TL	10/30/90
trans-1.3-Dichloropropylene	<10	UG/L	SW 8010	TL	10/30/90
1,1.2,2-Tetrachloroethane	<10	UG/L	5W 8010	TL	10/30/90
1,1,1,2-Tetrachloroethane	<10	UG/L	SW 8010	TL	10/30/90
Tetrachloroethylene	₹10	U6/L	SW 8010	TL	10/30/90
1.1.1-Trichloroethane	₹10	UG/L	SW 8010	TL	10/30/90
1,1,2-Trichloroethane	<10	UG/L	5₩ 8010	TL	10/30/90
Trichloroethylene	<10	UG/L	SW 8010	TL	10/30/90
Trichlorofluoromethane	<10	UG/L	SW 8010	TL	10/30/90

Approved by Mishal Yeller

If you have any questions about your results, please do not hesitate to contact the laboratory for clarification.

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2500 PRAIRIETON ROAD · P. O. BOX 959 · TERRE HAUTE, INDIANA 47808-0959

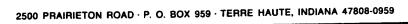
(812) 235-0838

			TEST RESULTS				
Report To: Ms. Deborah Simone Metcalf and Eddy, Inc. 10 Harvard Mill Square Wakefield, MA 01880		Date Received: Date Complete: CDC #:		Sample Description: Sample Date: Sample ID:		Water 10/24/90 MWB - 01	
TEST DESCRI	PTION	AESULT	UNITS	METHOD	ANALYST	DATE	
HOI DEENOTED	VOLATILE DREANICS	- CONT.					
Trichloro		₹10	UG/L	S¥ 8010	TL	10/30/90	0
Vinvl chl		<10	U6/L	SW 8010	TL	10/30/99)
AROMATIC VO	LATILE ORGANICS						
Benzene		₹10	UG/L	SW 8020	TL	10/30/99	
Chloroben	zene	<10	U6/L	SW 8020	TL	10/30/99	
1.4-Dichl	orobenzene	<10	US/L	SW 8020	TL	10/30/9	
1.3-Dichl	oropenzene	<10	U6/L	SW 8020	TL	10/30/90	
	probenzene	₹10	NB/L	SW 8020	TL	10/30/99	
Ethyl Ben		₹10	UG/L	SW 8020	TL	10/30/99	
Toluene		₹10	76\F	5₩ 8020	TL	10/30/9	
Xylenes		<10	VG/L	SW 8020	TL	10/30/99)

Approved by Muhal Laeller

If you have any questions about your results, please do not hesitate to contact the laboratory for clarification.

Page 2 of 16





TEST RESULTS ===========

Report To: Ms. Deborah Simone Metcalf and Eddy, Inc. 10 Harvard Mill Square

Date Received: 10/24/90 Date Complete: 11/05/90 4420 COC #:

Sample Description: Water Sample Date: Sample ID:

10/24/90 MM5 - 02

Wakefield, MA 01880

TEST DESCRIPTION	RESULT	UNITS	METHOD	ANALYST	DATE
HALDGENATED VOLATILE DREANICS					
Benzyl chloride	<10	U6/L	SW 8010	TL	10/30/90
Bis(2-chloroethoxy)methane	₹10	UG/L	SW 8010	TL	10/30/90
Bis(2-chloroisopropyl)ether	₹10	UG/L	SW 8010	TL	10/30/90
Bromobenzene	<10	U6/L	S₩ 8010	TL	10/30/90
Bromodichloromethane	<10	UG/L	SW 8010	TL	10/30/90
Bronoform	₹10	UG/L	SW 8010	TL	10/30/90
Bromomethane	<10	U6/L	SW 8010	TL	10/30/90
Carbon tetrachloride	<10	U6/L	S₩ 8010	TL	10/30/90
Chloroacetaldehyde	₹10	U6/L	SW 8010	TL	10/30/90
Chlorobenzene	₹10	UG/L	S₩ 8010	TL	10/30/90
Chloroethane	₹10	UG/L	SW 8010	TL	10/30/90
Chloroform	<10	UG/L	SW 8010	TL	10/30/90
1-Chlorohexane	₹10	UG/L	SW 8010	TL	10/30/90
2-Chloroethyl vinyl ether	<10	UG/L	SW 8010	TL	10/30/90
Chloromethane	₹10	UG/L	SW 8010	TL	10/30/90
Chloromethylmethyl ether	₹10	UG/L	SW 8010	TL	10/30/90
Chlorotoluene	₹10	UG/L	SW 8010	TL	10/30/90
Dibromochloromethane	⟨10	U6/L	SN 8010	TL	10/30/90
Dibromomethane	₹10	U6/L	S₩ 8010	TL	10/30/90
1,2-Dichlorobenzene	<10	U6/L	SW 8010	TL	10/30/90
1,3-Dichlorobenzene	₹10	UG/L	SW 8010	TL	10/30/90
1,4-Dichlorobenzene	₹10	UG/L	SN 8010	ΤL	10/30/90
Dichlorodifluoromethane	₹10	U6/L	SW 8010	TL	10/30/90
1,1-Dichloroethane	<10	U6/L	SW 8010	TL	10/30/90
1,2-Dichloroethane	<10	UG/L	S₩ 8010	TL	10/30/90
1,1-Dichloroethylene	<10	U6/L	SW B010	TL	10/30/90
trans-1,2-Dichloroethylene	₹10	UG/L	SW 8010	TL	10/30/90
Dichloromethane	<10	UG/L	SW 8010	TL	10/30/90
1,2-Bichloropropane	₹10	UG/L	SW 8010	TL	10/30/90
trans-1,3-Dichloropropylene	₹10	UG/L	SW 8010	TL	10/30/90
1,1,2,2-Tetrachloroethane	₹10	UG/L	SW 8010	TL	10/30/90
1,1,1,2-Tetrachloroethane	⟨10	UG/L	SW 8010	TL	10/30/90
Tetrachloroethylene	⟨10	U6/L	SW 8010	TL	10/30/90
1,1,1-Trichloroethane	⟨10	UG/L	SN 8010	TL	10/30/90
1,1,2-Trichloroethane	₹10	UG/L	S₩ 8010	TL	10/30/90
Trichloroethylene	₹10	UG/L	SW 8010	TL	10/30/90
Trichlorofluoromethane	(10	U6/L	SW 8010	TL	10/30/90
(F) Enior of luor paername	1 ```				

If you have any questions about your results, please do not hesitate to contact the laboratory for clarification.

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TEST RESULTS ______

Report To: Ms. Deborah Simone Metcalf and Eddy, Inc. 10 Harvard Mill Square Wakefield, MA 01880

Date Received: 10/24/90 Date Complete: 11/05/90 COC #:

4420

Sample Description: Water Sample Date: Sam

10/24/90

mple	ID:		HW5	-	02

TEST DESCRIPTION	RESULT	UNITS	METHOD	ANALYST	DATE
HALOGENATED VOLATILE ORGANICS - Trichloropropane Vinyl chloride	CONT. <10 <10	UG/L UG/L	SW 8010 SW 8010	TL TL	10/30/90 10/30/90
AROMATIC VOLATILE ORGANICS Benzene Chlorobenzene 1,4-Dichlorobenzene 1,3-Dichlorobenzene 1,2-Dichlorobenzene Ethyl Benzene Toluene Xylenes	<10 <10 <10 <10 <10 <10 <10 <10 <10 <10	UG/L UG/L UG/L UG/L UG/L UG/L UG/L UG/L	SW 8020 SW 8020 SW 8020 SW 8020 SW 8020 SW 8020 SW 8020 SW 8020	TL TL TL TL TL TL TL	10/30/90 10/30/90 10/30/90 10/30/90 10/30/90 10/30/90 10/30/90

Approved by Mishal Selle

If you have any questions about your results, please do not hesitate to contact the laboratory for clarification.



TEST RESULTS -----

Report To: Ms. Deborah Simone Metcalf and Eddy, Inc. 10 Harvard Mill Square

Date Received: 10/24/90 Date Complete: 11/05/90 COC #: 4420

Sample Date: Sample ID:

Sample Description: Water 10/24/90 MW6 -03

Wakefield, MA 01880

TEST DESCRIPTION	RESULT	UNITS	METHOD	ANALYST	DATE
HALOGENATED VOLATILE ORGANICS		****			
Benzyl chloride	<10	UG/L	SW 8010	TL	10/30/90
Bis(2-chloroethoxy)methane	₹10	UG/L	S₩ 8010	TL	10/30/90
Bis(2-chloroisopropyl)ether	₹10	UG/L	SW 8010	TL	10/30/90
Bromobenzene	<10	UG/L	SW 8010	TL	10/30/90
Bromodichloromethane	₹10	UG/L	SW 8010	TL	10/30/90
Bromoform	₹10	U6/L	SW 8010	TL	10/30/ 9 0
Bromomethane	₹10	UG/L	SW 8010	TL	10/30/90
Carbon tetrachloride	<10	UG/L	SW 8010	TL	10/30/90
Chloroacetaldehyde	<10	UG/L	S# 8010	TL	10/30/90
Chlorobenzene	₹10	UG/L	SW 8010	TL	10/30/90
Chloroethane	<10	UG/L	SW 8010	TL	10/30/90
Chloroform	<10	UG/L	SW 8010	TL	10/30/90
1-Chlorohexane	<10	UG/L	SW 8010	TL	10/30/90
2-Chloroethyl vinyl ether	₹10	UG/L	SW 8010	TL	10/30/90
Chloromethane	<10	UG/L	SW 8010	TL	10/30/90
Chloromethylmethyl ether	⟨10	UG/L	SW 8010	TL	10/30/90
Chlorotoluene	⟨10	UG/L	SW 8010	TL	10/30/90
Dibromochloromethane	₹10	UG/L	SW 8010	TL	10/30/90
Dibromomethane	₹10	UG/L	SW 8010	TL	10/30/90
1,2-Bichlorobenzene	₹10	UG/L	SW 8010	TL	10/30/90
1,3-Dichlorobenzene	⟨10	UG/L	SW 8010	TL	10/30/90
1,4-Dichlorobenzene	⟨10	UG/L	SW 8010	TL	10/30/90
Dichlorodifluoromethane	<10	UG/L	SW 8010	TL	10/30/90
1.1-Dichloroethane	⟨10	U6/L	SW 8010	TL	10/30/90
1,2-Dichloroethane	<10	U6/L	SW 8010	TL	10/30/90
1,1-Dichloroethylene	⟨10	U6/L	SW 8010	TL	10/30/90
trans-1,2-Dichloroethylene	₹10	U6/L	SW 8010	TL	10/30/90
Dichloromethane	₹10	U6/L	SW 8010	TL	10/30/90
1.2-Dichloropropane	<10	NG/L	SW 8010	TL	10/30/90
trans-1,3-Dichloropropylene	<10	U6/L	SW 8010	TL	10/30/90
1,1,2,2-Tetrachloroethane	₹10	U6/L	SW 8010	TL	10/30/90
1,1,1,2-Tetrachloroethane	<10	UG/L	SW 8010	TL	10/30/90
Tetrachloroethylene	⟨10	U6/L	SW 8010	TL	10/30/90
1,1,1-Trichloroethane	<10	U6/L	SW 8010	TL	10/30/90
1.1.2-Trichloroethane	₹10	UG/L	SW 8010	TL	10/30/90
Trichloroethylene	₹10	UG/L	SW 8010	TL	10/30/90
Trichlorofluoromethane	₹10	UG/L	SW 8010	TL	10/30/90

Approved by Misher Steller

If you have any questions about your results, please do not hesitate to contact the laboratory for clarification.

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TEST RESULTS

Report To: Ms. Deborah Simone Metcalf and Eddy, Inc. 10 Harvard Mill Square Wakefield, MA 01880

Date Received: 10/24/90 Date Complete: 11/05/90 COC #:

4420

Sample Description: Water Sample Date:

10/24/90

Sample ID:

MW6 -03

#BRE12239					
TEST DESCRIPTION	RESULT	UNITS	METHOD	ANALYST	DATE
WALDGENATED HOLATHE GOCANICO					
HALDGENATED VOLATILE ORGANICS	- CONT.	UG/L	SW 8010	TL	10/30/90
Trichloropropane Vinyl chloride	⟨10	UG/L	SW 8010	TL	10/30/90
Vinyi Liibi ide					
AROMATIC VOLATILE ORGANICS					
Benzene	<10	UG/L	SW 8020	TL	10/30/90
Chlorobenzene	₹10	UG/L	S₩ 8020	TL	10/30/90
1.4-Dichlorobenzene	₹10	UG/L	SW 8020	TL	10/30/90
1,3-Dichlorobenzene	₹10	U6/L	S₩ 8020	TL	10/30/90
1,2-Dichlorobenzene	₹10	UG/L	SW 8020	TL	10/30/90
Ethyl Benzene	₹10	UG/L	SN 8020	TL	10/30/90
•	₹10	U6/L	SW 8020	TL	10/30/90
Toluene	₹10	UG/L	SW 8020	TL	10/30/90
Xylenes	/10	001 5	2" DATA	· 	

If you have any questions about your results, please do not hesitate to contact the laboratory for clarification.

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TEST RESULTS =========

Report To: Ms. Deborah Simone Metcalf and Eddy, Inc. 10 Harvard Mill Square Wakefield. MA 01880

Date Received: 10/24/90 Date Complete: 11/05/90 COC #: 4420

Sample Description: Sample Date: Sample ID:

Water 10/24/90 MW2 - 04

TEST DESCRIPTION	RESULT	UNITS	METHOD	ANALYST	DATE
HALOGENATED VOLATILE ORGANICS					
	₹10	U6/L	SW 8010	TL	10/30/90
Benzyl chloride	<10 <10	U6/L	SW 8010	TL	10/30/90
Bis(2-chloroethoxy)methane	<10 <10	U6/L	SW 8010	TL	10/30/90
Bis(2-chloroisopropyl)ether	₹10 ₹10	US/L	SW 8010	TL	10/30/90
Bromobenzene		U6/L	SW 8010	TL	10/30/90
Bromodichloromethane	<10	UG/L	SW 8010	TL	10/30/90
Bromoform	<10	06/L	SW 8010	TL	10/30/90
Bromomethane	₹10	UG/L	SW 8010	TL	10/30/90
Carbon tetrachloride	₹10		SW 8010	TL	10/30/90
Chloroacetaldehyde	₹10	U6/L	SW 8010	TL	10/30/90
Chlorobenzene	₹10	UG/L		TL	10/30/90
Ch1 or cethane	₹10	06/L	SW 8010	TL	10/30/90
Chloroform	35	UG/L	SW 8010	· -	10/30/70
1-Chlorohexane	<10	U6/L	SW 8010	TL Ti	10/30/90
2-Chloroethyl vinyl ether	<10	UG/L	SW 8010	TL -	
Chloromethane	₹10	UG/L	SW 8010	TL 	10/30/90
Chloromethylmethyl ether	₹10	UG/L	SW 8010	TL	10/30/90
Chlorotoluene	₹10	U6/L	SW 8010	TL	10/30/90
Dibromochloromethane	<10	NB/L	SW 8010	TL	10/30/90
Dibromomethane	₹10	ne\r	5W 8010	TL	10/30/90
1,2-Dichlorobenzene	<19	UG/L	SW 8010	TL	10/30/90
1.3-Dichlorobenzene	₹10	U6/L	SW 8010	TL	10/30/90
1,4-Dichlorobenzene	₹10	UG/L	SW 8010	TL	10/30/90
Dichlorodifluoromethane	₹10	UG/L	SW 8010	TL	10/30/90
1.1-Dichloroethane	₹10	UG/L	SW 8010	TL	10/30/90
1.2-Dichloroethane	₹10	U6/L	SW 8010	TL	10/30/90
1,1-Dichloroethylene	₹10	UG/L	SW 8010	TL	10/30/90
trans-1,2-Dichloroethylene	<10	UG/L	SW 8010	TL	10/30/90
Dichloromethane	₹10	UG/L	5W 8010	TL	10/30/90
1.2-Dichloropropane	₹10	U6/L	SW 8010	TL	10/30/90
trans-1,3-Dichloropropylene	₹10	UG/L	SW 8010	TL	10/30/90
1,1,2,2-Tetrachloroethane	₹10	U6/L	SW 8010	TL	10/30/90
1 1 1 7-Tetrachiornethane	(10	V6/L	SW 8010	TL	10/30/90

UG/L

UG/L

UG/L

86/L

UG/L

SW 8010

SW 8010

SW 8010

SW 8010

SW 8010

TL

TL

TL

TL

TL

Approved by ____

1,1,1.2-Tetrachloroethane

Tetrachloroethylene

1,1,1-Trichloroethane

1.1.2-Trichloroethane

Trichlorofluoromethane

Trichloroethylene

If you have any questions about your results, please do not hesitate to contact the laboratory for clarification.

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<10

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10/30/90

10/30/90

10/30/90

10/30/90

10/30/90





TEST RESULTS =========

Report To: Ms. Deborah Simone Metcalf and Eddy, Inc. 10 Harvard Mill Square Wakefield, MA 01880

Date Received: 10/24/90 Date Complete: 11/05/90 4420 COC #:

Sample Description: Water Sample Date: Sample ID:

10/24/90

MW2 - 04

TEST DESCRIPTION	RESULT	UNITS	METHOD	ANALYST	DATE
HALDGENATED VOLATILE ORGANICS Trichloropropane	6 - CONT. <10	UG/L	SW 8010	TL .	10/30/90
Vinyl chloride	<10	UG/L	SW 8010	TL	10/30/90
AROMATIC VOLATILE ORGANICS				T ;	10/30/90
Benzene	₹10	UG/L	SW 8020	TL -	
Chlorobenzene	₹10	UG/L	5₩ 8020	TL	10/30/90
1,4-Dichlorobenzene	₹10	UG/L	S₩ 8020	TL	10/30/90
1,3-Dichlorobenzene	⟨10	UG/L	SW 8020	TL	10/30/90
1,2-Dichlorobenzene	<10	U6/L	S# 8020	TL	10/30/90
•	₹10	UG/L	SW 8020	TL	10/30/90
Ethyl Benzene	<10	UG/L	SW 8020	TL	10/30/90
Toluene Xylenes	<10 <10	U6/L	SW 8020	TL	10/30/90

Approved by Mukul Seller

If you have any questions about your results, please do not hesitate to contact the laboratory for clarification.

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(812) 235-0838

TEST RESULTS =========

Report To: Ms. Deborah Simone Metcalf and Eddy, Inc. 10 Harvard Mill Square Wakefield, MA 01880

Date Received: 10/24/90 Date Complete: 11/05/90 4420 COC #:

Sample Description: Water Sample Date: Sample ID:

10/24/90 MW04 -05

WENCHIELD IN VIOL	RESULT	UNITS	METHOD	ANALYST	DATE
TEST DESCRIPTION	MEDULI	כונאט	1111100		
HALOGENATED VOLATILE ORGANICS					
Benzyl chloride	<10	U6/L	SW 8010	TL	10/30/90
Bis(2-chloroethoxy)methane	<10	U6/L	SW 8010	TL	10/30/90
Bis(2-chloroisopropyl)ether	<10	U6/L	SW 8010	ŢĹ	10/30/90
Bromobenzene	<10	UG/L	SW 8010	īL	10/30/90
Bromodichloromethane	<10	U6/L	SW 8010	TL	10/30/90
Brosofors	<10	U6/L	SW 8010	TL	10/30/90
Brompethane	<10	U6/L	SW 8010	TL	10/30/90
Carbon tetrachloride	<10	U6/L	SW 8010	ΤL	10/30/90
Chloroacetaldehyde	<10	U6/L	SW 8010	TL	10/30/90
Chlorobenzene	<10	U6/L	SW 8010	TL	10/30/90
Chloroethane	<10	UG/L	5₩ B010	TL	10/30/90
Chloroform	<10	UG/L	SW 8010	TL	10/30/90
i-Chlorohexane	<10	UG/L	SW 8010	TL	10/30/90
2-Chloroethyl vinyl ether	<10	UG/L	SW 8010	TL	10/30/90
Chloromethane	<10	UG/L	SW 8010	TL	10/30/90
Chloromethylmethyl ether	<10	UG/L	SW 8010	TL	10/30/90
Chlorotoluene	₹10	UG/L	SW 8010	TL	10/30/90
Dibromochloromethane	₹10	UG/L	SW 8010	TL	10/30/90
Dibrompmethane	⟨10	UG/L	SW 8010	TL	10/30/90
1,2-Dichlorobenzene	<10	UG/L	SW 8010	TL	10/30/90
1,3-Dichlorobenzene	₹10	UG/L	SW 8010	TL	10/30/90
1.4-Dichlorobenzene	₹10	UG/L	SW 8010	TL	10/30/90
Dichlorodifluoromethane	<10	UG/L	SW 8010	TL	10/30/90
1,1-Dichloroethane	₹10	UG/L	SW 8010	TL.	10/30/90
1,2-Dichloroethane	<10	UG/L	SW 8010	TL	10/30/90
1,1-Dichloroethylene	₹10	UG/L	SW 8010	TL	10/30/90
trans-1,2-Dichloroethylene	<10	UG/L	SW 8010	TL	10/30/90
Dichloromethane	₹10	UG/L	S₩ 8010	TL	10/30/90
1,2-Dichloropropane	₹10	UG/L	SW 8010	TL	10/30/90
trans-1,3-Dichloropropylene	<10	UG/L	SW 8010	TL	10/30/90
1,1,2,2-Tetrachloroethane	₹10	V6/L	SW 8010	TL	10/30/90
1,1,1,2-Tetrachloroethane	₹10	U6/L	SW 8010	TL	10/30/90
Tetrachloroethylene	<10	Ne/F	SW 8010	TL	10/30/90
1,1,1-Trichloroethane	₹10	UG/L	S# 8010	TL	10/30/90
1,1,2-Trichloroethane	₹10	U6/L	SW 8010	TL	10/30/90
Trichloroethylene	<10	UG/L	SW 8010	TL	10/30/90
Trichlorofluoromethane	. <10	U6/L	SW 8010	TL	10/30/90

Approved by Make Seller

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(812) 235-0838

TEST RESULTS -----

Report To: Ms. Deborah Simone Metcalf and Eddy, Inc. 10 Harvard Mill Square Wakefield, MA 01880

Date Received: 10/24/90 Date Complete: 11/05/90 COC #: 4420

Sample Description: Water Sample Date:

10/24/90

Sample ID:

NH04 -05

###E12224 1 V					
TEST DESCRIPTION	RESULT	UNITS	METHOD	ANALYST	DATE
HALOGENATED VOLATILE ORGANICS	S - CONT.				
Trichloropropane	₹10	UG/L	SW 8010	TL	10/30/90
Vinyl chloride	⟨10	U6/L	SW 8010	TL	10/30/90
AROMATIC VOLATILE ORGANICS					
Benzene	₹10	Ne\r	S# 8020	TL	10/30/90
Chlorobenzene	<10	UG/L	SW 8020	TL	10/30/90
1,4-Dichlorobenzene	<10	U6/L	S₩ 8020	TL	10/30/90
1,3-Dichlorobenzene	<10	UG/L	SW 8020	TL	10/30/90
1,2-Dichlorobenzene	<10	U6/L	5₩ 8020	TL	10/30/90
Ethyl Benzene	<10	UG/L	SW 8020	TL	10/30/90
Toluene	⟨10	UG/L	S# 8020	TL	10/30/90
Xylenes	<10	N6/F	SW 8020	TL	10/30/90

If you have any questions about your results, please do not hesitate to contact the laboratory for clarification.

(812) 235-0838



TEST RESULTS =========

Report To: Ms. Deborah Simone Metcalf and Eddy, Inc. 10 Harvard Hill Square Date Received: 10/24/90 Date Complete: 11/05/90 COC #: 4420

Sample Date: Sample ID:

Sample Description: Water 10/24/90 MW1 - 06

Wakefield, MA 01880

TEST DESCRIPTION	RESULT	UNITS	METHOD	ANALYST	DATE
HALOGENATED VOLATILE ORGANICS	*****			ڪ خد جد جد جد ت	
Benzyl chloride	<10	UG/L	SW 8010	TL	10/30/90
Bis(2-chloroethoxy)methane	₹10	UG/L	SW 8010	TL	10/30/90
Bis (2-chloroisopropyl) ether	<10	U6/L	SW 8010	TL	10/30/90
Broapbenzene	₹10	UG/L	SW 8010	TL	10/30/90
Bromodichloromethane	<10	U6/L	SW 8010	TL	10/30/90
Brosoform	<10	U6/L	SW 8010	TL	10/30/90
Bromomethane	₹10	U6/L	SW 8010	TL	10/30/90
Carbon tetrachloride	₹10	U6/L	SW 8010	TL	10/30/90
Chloroacetaldehyde	₹10	U6/L	SW 8010	TL	10/30/90
Chlorobenzene	₹10	U6/L	SW 8010	TL	10/30/90
Chloroethane	₹10	UG/L	SW 8010	TL	10/30/90
Chloroform	₹10	UG/L	SW 8010	TL	10/30/90
1-Chlorohexane	<10	U6/L	SW 8010	TL	10/30/90
2-Chloroethyl vinyl ether	₹10	UG/L	SW 8010	TL	10/30/90
Chloromethane	<10	UG/L	SW 8010	TL	10/30/90
Chloromethylmethyl ether	⟨10	UG/L	SW 8010	TŁ.	10/30/90
Chlorotoluene	<10	U6/L	SW 8010	TL	10/30/90
Dibromochloromethane	<10 <10	U6/L	SW 8010	TL	10/30/90
Dibromomethane	₹10	UG/L	SW 8010	TL	10/30/90
	₹10	U6/L	SW 8010	TL	10/30/90
1,2-Dichlorobenzene	₹10	U6/L	SW 8010	TL	10/30/90
1,3-Dichlorobenzene	<10 <10	U6/L	SW 8010	TL	10/30/90
1,4-Dichlorobenzene	<10 <10	UG/L	SW 8010	TL	10/30/90
Dichlorodifluoromethane	<10 <10	UG/L	SW 8010	TL	10/30/90
1,1-Dichloroethane	<10	V6/L	SW 8010	TL	10/30/90
1,2-Dichloroethane	₹10	U6/L	SW 8010	TL	10/30/90
1,1-Dichloroethylene	<10 <10	U6/L	SW 8010	TL	10/30/90
trans-1,2-Dichloroethylene	<10 <10	U6/L	SW 8010	TL	10/30/90
Dichloromethane	<10 <10	U6/L	5W 8010	TL	10/30/90
1,2-Dichloropropane	<10 <10	U6/L	SW 8010	TL	10/30/90
trans-1,3-Dichloropropylene	<10 <10	U6/L	SW 8010	TL	10/30/90
1,1,2,2-Tetrachloroethane		U6/L	SW 8010	TL	10/30/90
1,1,1,2-Tetrachloroethane	<10	U6/L	SW 8010	TL	10/30/90
Tetrachloroethylene	<10 <10	U6/L	SW 8010	TL	10/30/90
1,1,1-Trichloroethane	<10 <10	U6/L	SW 8010	TL	10/30/90
1,1,2-Trichloroethane		U6/L	SW 8010	τL	10/30/90
Trichloroethylene	(10	U6/L	SW 8010	TL	10/30/90
Trichlorofluoromethane	<10	חסור	3# DATA	16	********

Approved by Mishel Halle

If you have any questions about your results, please do not hesitate to contact the laboratory for clarification.

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(812) 235-0838

TEST RESULTS =========

Report To: Ms. Deborah Simone Metcalf and Eddy, Inc. 10 Harvard Mill Square Wakefield, MA 01880

Date Received: 10/24/90 Date Complete: 11/05/90 COC #: 4420

Sample Description: Water Sample Date: Sample ID:

10/24/90 MW1 - 06

WORLISCH THE TE					
TEST DESCRIPTION	RESULT	UNITS	METHOD	ANALYST	DATE
HALOGENATED VOLATILE ORGANICS	- CONT.				
Trichloropropane	⟨10	U6/L	5W 8010	TL	10/30/90
Vinyl chloride	<10	UG/L	SN 8010	TL	10/30/90
AROMATIC VOLATILE ORGANICS					
Benzene	<10	UG/L	SW 8020	TL	10/30/90
Chlorobenzene	<10	Ne/L	SW 8020	TL	10/30/90
1,4-Dichlorobenzene	₹10	U6/L	SW 8020	TL	10/30/90
1,3-Dichlorobenzene	₹10	UG/L	SW 8020	TL	10/30/90
1,2-Dichlorobenzene	₹10	UG/L	SW 8020	TL	10/30/90
Ethyl Benzene	₹10	UG/L	SW 8020	TL	10/30/90
Toluene	13	UG/L	SW 8020	TL	10/30/90
Xylenes	<10	U6/L	SW 8020	TL	10/30/90

Approved by Mishell Shelle

If you have any questions about your results, please do not hesitate to contact the laboratory for clarification.

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TEST RESULTS =========

Report To: Ms. Deborah Simone Metcalf and Eddy, Inc. 10 Harvard Mill Square

Date Received: 10/24/90 Date Complete: 11/05/90 4420 COC #:

Sample Description: Water Sample Date: Sample ID:

10/24/90 Piez. 1-8

Wakefield, MA 01880

HALOSEMATED VOLATILE ORSANICS Benzyl chloride Clo	TEST DESCRIPTION	RESULT	UNITS	METHOD	ANALYST	DATE
Benzyl chloride	HALOGENATED VOLATILE ORGANICS	*****	*****			
Bis (2-chloroethoxy)		<10	U6/L			
Bis (2-chloroisopropyl) ether (10	•	<10	UG/L	SW 8010		
Bromotenzene		<10	UG/L			
Broadore 10		<10	U6/L			
Bromoform	Bromodichloromethane	₹10	U6/L	SW B010		
Carbon tetrachloride	= = :	<10	UG/L			
Chloroacetaldehyde	Bromomethane	<10	U6/L			
Chlorobetane	Carbon tetrachloride	<10	UG/L	SW 8010		
Chlorobenzene	Chloroacetaldehyde	<10	U6/L			
Chloroform (10 UB/L SN 8010 TL 10/31/90 1-Chloromexane (10 UB/L SN 8010 TL 10/31/90 2-Chloromethyl vinyl ether (10 UB/L SN 8010 TL 10/31/90 Chloromethyl ether (10 UB/L SN 8010 TL 10/31/90 Chloromethyl ether (10 UB/L SN 8010 TL 10/31/90 Chloromethyl ether (10 UB/L SN 8010 TL 10/31/90 Chloromethyl ether (10 UB/L SN 8010 TL 10/31/90 Chloromethane (10 UB/L SN 8010 TL 10/31/90 Dibromomethane (11 UB/L SN 8010 TL 10/31/90 Dibromomethane (10 UB/L SN 8010 TL 10/31/90 Il,2-Dichloromethane (10 UB/L SN 8010 TL 10/31/90 Il,3-Dichloromethane (10 UB/L SN 8010 TL 10/31/90 Il,4-Dichloromethane (10 UB/L SN 8010 TL 10/31/90 Il,4-Dichloromethane (10 UB/L SN 8010 TL 10/31/90 Il,1-Dichloromethane (10 UB/L SN 8010 TL 10/31/90 Il,1-Dichloromethane (10 UB/L SN 8010 TL 10/31/90 Il,1-Dichloromethane (10 UB/L SN 8010 TL 10/31/90 Il,1-Dichloromethylene (10 UB/L SN 8010 TL 10/31/90 Il,1-Dichloromethylene (10 UB/L SN 8010 TL 10/31/90 Il,1-Dichloromethylene (10 UB/L SN 8010 TL 10/31/90 Il,1-Dichloromethylene (10 UB/L SN 8010 TL 10/31/90 Il,1-Dichloromethane (10 UB/L SN 8010 TL 10/31/90 Il,1-Dichloromethane (10 UB/L SN 8010 TL 10/31/90 Il,1-Z-Tetrachloromethane (10 UB/L SN 8010 TL	•	<10	UG/L	SW 8010		
Chloroform		₹10	UG/L	SW 8010	TL	
1-Chlorohexane	_	<10	U6/L	SW 8010		
2-Chloroethyl vinyl ether		<10	U6/L	SM 8010		
Chloromethane	• • • • • • • • • • • • • • • • • • • •	<10	U6/L	SW 8010		
Chloromethylmethyl ether		<10	UG/L	SW 8010		
Chlorotoluene		<10	UG/L			
Dibromochloromethane		<10	UG/L	SW 8010		
Dibromomethane		11	UG/L	SW 8010		
1,2-Dichlorobenzene <10		₹10	UG/L	SW 8010		
1,3-Dichlorobenzene (10 UG/L SM 8010 TL 10/31/90 1,4-Dichlorobenzene (10 UG/L SM 8010 TL 10/31/90 Dichlorodifluoromethane (10 UG/L SM 8010 TL 10/31/90 1,1-Dichloroethane (10 UG/L SM 8010 TL 10/31/90 1,2-Dichloroethylene (10 UG/L SM 8010 TL 10/31/90 1,1-Dichloroethylene (10 UG/L SM 8010 TL 10/31/90 1,1-Dichloroethylene (10 UG/L SM 8010 TL 10/31/90 trans-1,2-Dichloroethylene (10 UG/L SM 8010 TL 10/31/90 1,2-Dichloropropane 24 UG/L SM 8010 TL 10/31/90 1,1,2-Tetrachloroethane (10 UG/L SM 8010 TL 10/31/90 1,1,2-Tetrachloroethane (10 UG/L SM 8010 TL 10/31/90 1,1,1-Trichloroethane (10 UG/L SM 8010 TL 10/31/90 1,1,2-Trichloroethane (10 UG/L SM 8010 <t< td=""><td></td><td><10</td><td>U6/L</td><td>SW 8010 ·</td><td>TL</td><td></td></t<>		<10	U6/L	SW 8010 ·	TL	
1,4-Dichlorobenzene		₹10	UG/L	SW 8010	TL	10/31/90
Dichlorodifluoromethane (10 UG/L SW 8010 TL 10/31/90 1,1-Dichloroethane (10 UG/L SW 8010 TL 10/31/90 1,2-Dichloroethane (10 UG/L SW 8010 TL 10/31/90 1,1-Dichloroethylene (10 UG/L SW 8010 TL 10/31/90 trans-1,2-Dichloroethylene (10 UG/L SW 8010 TL 10/31/90 1,2-Dichloropropane 24 UG/L SW 8010 TL 10/31/90 1,2-Dichloropropylene (10 UG/L SW 8010 TL 10/31/90 1,2-Dichloropropylene (10 UG/L SW 8010 TL 10/31/90 1,1,2-Tetrachloroethane (10 UG/L SW 8010 TL 10/31/90 1,1,1-Trichloroethane (10 UG/L SW 8010 TL 10/31/90 1,1,2-Trichloroethane (10 UG/L SW 8010 TL 10/31/90 1,1,2-Trichloroethane (10 UG/L SW 8010 TL 10/31			UG/L	SW 8010	TL	
1,1-Dichloroethane <10			UG/L	SW 8010	TL	10/31/90
1,2-Dichloroethane			UG/L	SW 8010	TL	10/31/90
1,1-Dichloroethylene <10			UG/L	SW 8010	TL	10/31/90
trans-1,2-Dichloroethylene <10			UG/L	SW 8010	TL	10/31/90
Dichloromethane 410 UG/L SW 8010 TL 10/31/90 1,2-Dichloropropane 24 UG/L SW 8010 TL 10/31/90 trans-1,3-Dichloropropylene 410 UG/L SW 8010 TL 10/31/90 1,1,2,2-Tetrachloroethane 410 UG/L SW 8010 TL 10/31/90 1,1,1,2-Tetrachloroethane 410 UG/L SW 8010 TL 10/31/90 Tetrachloroethylene 13 UG/L SW 8010 TL 10/31/90 1,1,1-Trichloroethane 410 UG/L SW 8010 TL 10/31/90 1,1,2-Trichloroethane 10 UG/L SW 8010 TL 10/31/90 1,1,2-Trichloroethylene 40 UG/L SW 8010 TL 10/31/90 1,1,2-Trichloroethylene 40 UG/L SW 8010 TL 10/31/90 1,1,2-Trichloroethylene 40 UG/L SW 8010 TL 10/31/90			UG/L	SW 8010	TL	10/31/90
1,2-Dichloropropane 24 UG/L SW 8010 TL 10/31/90 trans-1,3-Dichloropropylene <10				SW 8010	TL	10/31/90
trans-1,3-Dichloropropylene <10 UG/L SW 8010 TL 10/31/90 1,1,2,2-Tetrachloroethane <10 UG/L SW 8010 TL 10/31/90 1,1,1,2-Tetrachloroethane <10 UG/L SW 8010 TL 10/31/90 Tetrachloroethylene 13 UG/L SW 8010 TL 10/31/90 1,1,1-Trichloroethane <10 UG/L SW 8010 TL 10/31/90 1,1,2-Trichloroethane 10 UG/L SW 8010 TL 10/31/90 1,1,2-Trichloroethane 10 UG/L SW 8010 TL 10/31/90 Trichloroethylene <10 UG/L SW 8010 TL 10/31/90				SW 8010	TL	10/31/90
1,1,2,2-Tetrachloroethane <10		_		SW 8010	TL	10/31/90
1,1,1,2-Tetrachloroethane <10				SW 8010	TL	10/31/90
Tetrachloroethylene 13 UG/L SW 8010 TL 10/31/90 1,1,1-Trichloroethane (10 UG/L SW 8010 TL 10/31/90 1,1,2-Trichloroethane 10 UG/L SW 8010 TL 10/31/90 Trichloroethylene (10 UG/L SW 8010 TL 10/31/90				SW 8010	TL	10/31/90
1,1,1-Trichloroethane					TL	10/31/90
1,1,2-Trichloroethane 10 UG/L SW 8010 TL 10/31/90 Trichloroethylene <10 UG/L SW 8010 TL 10/31/90					TL	10/31/90
Trichloroethylene (10 UG/L SN 8010 TL 10/31/90						10/31/90
if leading declay tene						10/31/90
	Trichlorofluoromethane	\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \	U6/L	SW 8010		10/31/90

Approved by Muster Soeller

If you have any questions about your results, please do not hesitate to contact the laboratory for clarification.

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(812) 235-0838

TEST RESULTS ______

Report To: Ms. Deborah Simone Metcalf and Eddy, Inc. 10 Harvard Hill Square Wakefield, MA 01880

Date Received: 10/24/90 Date Complete: 11/05/90

COC #: 4420 Sample Description: Water Sample Date:

10/24/90

Sample ID:

Piez. 1-8

Makerielu, na vi	000				
TEST DESCRIPTION	RESULT	UNITS	METHOD	ANALYST	DATE
HALOGENATED VOLATILE ORGANICS Trichloropropane Vinyl chloride	<pre>- CONT. <10 <10</pre>	U6/L U6/L	SW 8010 SW 8010	TL TL	10/31/90 10/31/90
AROMATIC VOLATILE ORGANICS Benzene Chlorobenzene 1,4-Dichlorobenzene 1,3-Dichlorobenzene 1,2-Dichlorobenzene Ethyl Benzene Toluene Xylenes	37 <10 <10 <10 <10 <10 <10	U6/L U6/L U6/L U6/L U6/L U6/L U6/L	SW 8020 SW 8020 SW 8020 SW 8020 SW 8020 SW 8020 SW 8020 SW 8020	TL TL TL TL TL TL TL	10/31/90 10/31/90 10/31/90 10/31/90 10/31/90 10/31/90 10/31/90 10/31/90

Approved by Bulul Saeller

If you have any questions about your results, please do not hesitate to contact the laboratory for clarification.

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(812) 235-0838

TEST RESULTS -------

Report To: Ms. Deborah Simone Metcalf and Eddy, Inc. 10 Harvard Mill Square Date Received: 10/24/90 Date Complete: 11/05/90 COC #: 4420

Sample Description: Water Sample Date: Sample ID:

10/24/90 Trip Blank

10 maryaro	B111	phnati
Wakefield,	MA (08810

TEST DESCRIPTION	RESULT	UNITS	METHOD	ANALYST	DATE
HALDGENATED VOLATILE ORGANICS					•
Benzyl chloride	<10	UG/L	SW 8010	TL	10/30/90
Bis(2-chloroethoxy)methane	<10	U6/L	SN 8010	TL	10/30/90
Bis(2-chloroisopropyl)ether	<10	U6/L	SW 8010	TL	10/30/90
Bromobenzene	<10	UG/L	SW 8010	TL	10/30/90
Bromodichloromethane	<10	UG/L	SW 8010	TL	10/30/90
Bromoform	<10	UG/L	SW 8010	TL	10/30/90
Bromomethane	₹10	U6/L	SW 8010	TL	10/30/90
Carbon tetrachloride	₹10	UG/L	SW 8010	TL	10/30/90
Chloroacetaldehyde	<10	U6/L	SW 8010	TL	10/30/90
Chlorobenzene	<10	U6/L	SW 8010	TL	10/30/90
Chloroethane	<10	UG/L	SW 8010	TL	10/30/90
Chloroform	<10	UG/L	SW 8010	TL	10/30/90
1-Chlorohexane	<10	UG/L	SW 8010	TL	10/30/90
2-Chloroethyl vinyl ether	₹10	UG/L	SW 8010	TL	10/30/90
Chloromethane	<10	UG/L	SW 8010	TL	10/30/90
Chloromethylmethyl ether	<10	UG/L	SW 8010	TL	10/30/90
Chlorotoluene	₹10	UG/L	SW 8010	TL	10/30/90
Dibromochloromethane	<10	UG/L	SW 8010	TL	10/30/90
Dibromomethane	<10	U6/L	5W 8010	TL	10/30/90
1,2-Dichlorobenzene	<10	UG/L	SW 8010	TL	10/30/90
1,3-Dichlorobenzene	<10	UG/L	SW 8010	TL	10/30/90
1,4-Dichlorobenzene	<10	U6/L	SW 8010	TL	10/30/90
Dichlorodifluoromethane	<10	UG/L	SW 8010	TL	10/30/90
1,1-Dichloroethane	<10	U6/L	SW 8010	TL	10/30/90
1,2-Dichloroethane	<10	U6/L	SW 8010	TL	10/30/90
1.1-Dichloroethylene	₹10	UG/L	SW 8010	TL	10/30/90
trans-1,2-Dichloroethylene	<10	UG/L	SW 8010	TL	10/30/90
Dichloromethane	<10	UG/L	SW 8010	TL	10/30/90
1,2-Dichloropropane	<10	UG/L	SW 8010	TL	10/30/90
trans-1,3-Dichloropropylene	<10	UG/L	SW 8010	TL	10/30/90
1,1,2,2-Tetrachloroethane	₹10	UG/L	SW 8010	TL.	10/30/90
1,1,1,2-Tetrachloroethane	<10	UG/L	SW 8010	TL	10/30/90
Tetrachloroethylene	<10	UG/L	SW 8010	TL	10/30/90
1,1,1-Trichloroethane	₹10	UG/L	SW 8010	TL	10/30/90
1,1,2-Trichloroethane	₹10	UG/L	SW 8010	TL	10/30/90
Trichloroethylene	<10	UG/L	5₩ B010	TL	10/30/90
Trichlorofluoromethane	(10	UG/L	SW 8010	TL	10/30/90

If you have any questions about your results, please do not hesitate to contact the laboratory for clarification.

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(812) 235-0838

TEST	RESULTS

Report To: Ms. Deborah Simone Metcalf and Eddy, Inc. 10 Harvard Mill Square Wakefield, MA 01880

Date Received: 10/24/90 Date Complete: 11/05/90 4420 COC #:

Sample Description: Water Sample Date: Sample ID:

10/24/90 Trip Blank

TEST DESCRIPTION	RESULT	UNITS	METHOD	ANALYST	DATE
HALDGENATED VOLATILE ORGANICS	- CONT.			_	
Trichloropropane	₹10	UG/L	SW 8010	TL	10/30/90
Vinyl chloride	<10	UG/L	SW 8010	TL	10/30/90
ARDMATIC VOLATILE ORGANICS					
Benzene	<10	UG/L	SM 8020	TL	10/30/90
Chlorobenzene	<10	UG/L	SW 8020	TL	10/30/90
1,4-Dichlorobenzene	₹10	U6/L	SW 8020	ΤL	10/30/90
1,3-Dichlorobenzene	⟨10	UG/L	SW 8020	TL	10/30/90
•	<10	U6/L	SW 8020	TL	10/30/90
1,2-Dichlorobenzene	<10	UG/L	SW 8020	TL	10/30/90
Ethyl Benzene	= :	U6/L	SW 8020	TL	10/30/90
Toluene	₹10		SW 8020	TL .	10/30/90
Xylenes	<10	U6/L	3# BUZU	11.	10/30/10

Approved by Weihal Speller

If you have any questions about your results, please do not hesitate to contact the laboratory for clarification.

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CHAIN OF CUSTODY RECORD

TERRE HAUTE, INDIANA 47808-0959

TEL (812) 235-0838 PW 10/31

Please observe requested QA/OC.

- DISTRIBUTION: Original accompanies shipment; Copy to Coordinator Field Files. REMARKS OR OBSERVATIONS Received by: (Signature) Received by: (Signature) Time Time Date Relinquished by: (Signature) Relinquished by: (Signature) 8 Q R Preservative Date NO. OF CONTAINERS Received for Laboratory by: (Signature) Method of Shipment: SEQ. ト | K | Received by: (Signature) Received by: (Signature) Other (Specify) SAMPLE TYPE X Water Scomp. Grab. بر L X Ł Y للا SAMPLERS (Signature) ပွ Time /SE3/ Time Chest Temp TIME Date 427 Date DATE Sample Chest STATION LOCATION Relinquished by: (Signature) Trip 6/2nK Relinquished by: (Signature) G0 / - 05 ا ٥ MW6-03 MW 6-03 mw2-04 mw 2-04 40-20-4WM 0 mwB-0 Tag # 1442の Chain of Custody MWB PLANT CODE RMRelinguished MWY SAMPLERS (Signature) STATION MM

VET 1 12/87



CHAIN OF CUSTODY FORM

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Lab (Samples Sent To):	Sent To):	. 1	Env.		MATRIX		(N/	AMALYSIS	ANALYSIS REQUESTED	Q	
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10/21/90	1150	40-8MM		Х		J.	7 / 1			7	
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Method of Shipment:	hipment:					1					
Distribution:	Original to Lab.	b. Copy 1 to Field Files,	Copy 2	to Project Manager							

APPENDIX G Toxicity Profiles

Acetone

Absorption - Acetone is readily absorbed by all routes of exposures. It has been reported that approximately 71% of inhaled acetone vapor is absorbed (Clayton and Clayton, 1982).

Distribution - Due to the high water solubility of acetone, it is widely distributed in body tissues. Exposure to radio-labeled carbon in acetone has resulted in observations of the labeled carbon in cholesterol, hepatic glycogen, amino acids, and carcass proteins in rats (Clayton and Clayton, 1982).

Metabolism - No information was located.

Carcinogenicity - Mutagenicity has not been shown and there are no data on possible carcinogenicity, so acetone is presently classified in Group D, not classifiable as to human carcinogenicity (Table G-1) (U.S. EPA, 1993).

Threshold Effects - A concentration of 500 ppm acetone in air is an irritant to the eyes, nose, and throat (Clement Associates, 1985). Very high concentrations in air (10,000 ppm) will cause central nervous system (CNS) depression, slight decreases in organ and body weights, and intoxication, headaches, and insomnia (Clement Associates, 1985). Exposure to the skin can cause defatting resulting in leathery, cracked skin. Acetone increases the toxic effects of trichloroethane (U.S. EPA, 1984); this is a relationship known as potentiation. Increased liver and kidney weights and nephrotoxicity have been documented following oral exposures of rats to acetone. Based on the above critical effects, a chronic oral RfD of 0.1 mg/kg/day has been developed by the U.S. EPA using an uncertainty factor of 1000 (U.S. EPA, 1993).

Reproductive/Developmental Effects - No information was located.

References

- Clayton and Clayton, 1982. Patty's Industrial Hygiene and Toxicology. Volume IIC Toxicology. Third Revised Edition.
- Clement Associates, Inc., 1985. Chemical, Physical and Biological Properties of Compounds Present at Hazardous Waste Sites. Prepared for U.S. EPA.
- U.S. EPA, 1984. Health Effects Assessment for Acetone. Office of Research and Development. Cincinnati, Ohio.
- U.S. EPA, 1993. Integrated Risk Information System (IRIS) online database; Acetone, dated 8/2/93.

TABLE G-1. WEIGHT OF EVIDENCE CLASSIFICATION

Group	Description
A	Human carcinogen
B1 or B2	Probable human carcinogen
	B1 indicates that limited human data are available
	B2 indicates sufficient evidence in animals and inadequate or no evidence in humans
C	Possible human carcinogen
D	Not classifiable as to human carcinogenicity
E	Evidence of noncarcinogenicity for humans

Source:

U.S. EPA. Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part A) Interim Final, December 1989.

2-Butanone (Methyl Ethyl Ketone)

Absorption - The absorption of 2-butanone resulting from exposure via inhalation or ingestion has been verified, but not quantified (U.S. EPA, 1984). Dermal absorption of 2-butanone is rapid from an aqueous solution.

Distribution - At high doses, 2-butanone affects the nervous system and irritates the eyes, mucous membranes, and skin (U.S. EPA, 1984).

Metabolism - No information available.

Carcinogenicity - 2-Butanone is classified in Group D based on lack of human carcinogenicity data and inadequate animal data (U.S. EPA, 1993).

Threshold Effects - Rat drinking water studies resulted in a chronic oral RfD based on decreased fetal birth weights. The chronic oral RfD is 0.6 mg/kg/day (U.S. EPA, 1993). For inhalation, the chronic RfC is 1.0 mg/m³ (U.S. EPA, 1993). Decreased fetal birth weights in mice is the critical effect.

Reproductive/Developmental Effects - Inhalation exposures to pregnant rats at levels of 500 ppm 2-butanone resulted in skeletal abnormalities and gross external and internal soft-tissue anomalies (U.S. EPA, 1984).

References

- U.S. EPA, 1984. Health Effects Assessment for 2-Butanone. Office of Research and Development. Cincinnati, Ohio.
- U.S. EPA, 1993. Integrated Risk Information System (IRIS) online database; 2-Butanone, dated 6/2/93.

Chloromethane

Absorption - No information available.

Distribution - No information available.

Metabolism - No information available.

Carcinogenicity - Based on a 24 month inhalation study with mice, chloromethane has been classified in Group C, a possible human carcinogen (U.S. EPA, 1994). An inhalation slope factor of 6.3×10^{-3} per mg/kg/day was derived from this study; tumors of the kidney were observed (U.S. EPA, 1994). Based on route to route extrapolation an oral slope factor of 1.3×10^{-2} per mg/kg/day has been derived (U.S. EPA, 1994).

Threshold Effects - A risk assessment for this substance is under review by an EPA work group (U.S. EPA, 1992).

Reproductive/Developmental Effects - No information available.

References

- U.S. EPA, 1992. Integrated Risk Information System (IRIS) online database; Chloromethane, dated 5/1/92.
- U.S. EPA, 1994. Health Effects Assessment Summary Tables, Annual FY 1994. Office of Research and Development Office of Emergency and Remedial Response, Washington, D.C., 9200.6-303(94-1).

Methylene Chloride

Absorption - Methylene chloride absorption occurs primarily via inhalation and ingestion. Some dermal absorption also occurs but at a slower rate (U.S. PHS, 1989).

Distribution - Following absorption, methylene chloride is quickly distributed to a wide range of tissues and body fluids. There is evidence of methylene chloride accumulation in body fats (U.S. PHS, 1989).

Metabolism - Methylene chloride is metabolized via two metabolic pathways; the mixed function oxidase system (MFO), where carbon monoxide and carbon dioxide are produced, and the glutathione S-transferase system (GST), which metabolizes methylene chloride at low exposures (U.S. PHS, 1989). Urinary excretion of methylene chloride has been observed in humans following inhalation exposure (U.S. PHS, 1989).

Carcinogenicity - Based on inhalation and drinking water studies with mice, methylene chloride has been classified in Group B2, a probable human carcinogen. Based on the development of lung tumors as a result of inhalation exposure, an inhalation unit risk of 4.7×10^{-7} per ug/m³ was generated. An oral slope factor of 7.5×10^{-3} per mg/kg/day was derived based on the development of liver tumors in mice (U.S. EPA, 1992).

Threshold Effects - Based on a 2-year chronic oral drinking water study of rats, a chronic oral RfD of 6 x 10⁻² mg/kg/day was developed (U.S. EPA, 1992). Liver toxicity was the critical effect observed. Based on a 2-year chronic inhalation study, a chronic inhalation RfC of 3 mg/m³ was derived; the critical effect reported was liver toxicity (U.S. EPA, 1994). An uncertainty factor of 100 was used for both studies (U.S. EPA, 1992; 1994).

Reproductive/Developmental Effects - Limited studies suggest that inhalation of methylene chloride at concentrations of 1250 ppm and above results in developmental and maternal toxicity (U.S. PHS, 1989).

References

- U.S. EPA, 1992. Integrated Risk Information System (IRIS) online database; Methylene Chloride, dated 1/20/92.
- U.S. EPA, 1994. Health Effects Assessment Summary Tables, Annual FY 1994. Office of Research and Development Office of Emergency and Remedial Response, Washington, D.C., 9200.6-303(94-1).
- U.S. Public Health Service (U.S. PHS), 1989. Toxicological Profile for Methylene Chloride.

1,2-Dichloroethene (trans)

Absorption - No studies were located; however, on the basis of its physical characteristics, environmental concentrations of this compound are expected to be readily absorbed through the skin and lungs, and by ingestion (U.S. EPA, 1987).

Distribution - No information available.

Metabolism - In vitro hepatocytes are known to metabolize cis-1,2-DCE at a faster rate than trans-1,2-DCE (U.S. EPA, 1987).

Carcinogenicity - No information on carcinogenicity is provided on IRIS (U.S. EPA, 1992).

Threshold Effects - The subchronic oral RfD for trans-1,2-dichloroethene was generated from a NOEL of 17 mg/kg/day resulting from a 90-day, subchronic drinking water study on mice. The critical effect was increased serum alkaline phosphatase in male mice. Doses ranged from 17 to 452 mg/kg/day. An uncertainty factor of 1000 was used to compensate for possible inter-species differences, uncertainty in the threshold for sensitive humans, and uncertainty when extrapolating from subchronic to chronic exposures. The chronic oral RfD generated from this study is 2 x 10⁻² mg/kg/day (U.S. EPA, 1992).

Reproductive/Developmental Effects - No information available.

References

- U.S. EPA, 1987. Health Advisory for 25 Organic Chemicals. March 31, 1987. Office of Drinking Water. Washington, D.C.
- U.S. EPA, 1992. Integrated Risk Information System (IRIS) online database; 1,2-Dichloroethene (trans), dated 1/22/92.

1,2-Dichloroethene (cis)

Absorption - No studies were located; however, on the basis of its physical characteristics, environmental concentrations of this compound are expected to be readily absorbed through the skin and lungs, and by ingestion (U.S. EPA, 1987).

Distribution - No information available.

Metabolism - In vitro hepatocytes are known to metabolize cis-1,2-DCE at a faster rate than trans-1,2-DCE (U.S. EPA, 1987). The rat liver converts cis-1,2-DCE to dichloroethanol and dichloroacetic acid (U.S. EPA, 1987).

Carcinogenicity - cis-1,2-Dichloroethene is listed in Group D, not classifiable. This is based on the lack of data from humans and animals and generally nonpositive results in mutagenicity assays (U.S. EPA, 1992).

Threshold Effects - The subchronic oral RfD for cis-1,2-dichloroethene is $1x10^{-1}$ mg/kg/day based on decreased hematrocrit and hemoglobin in a 90-day rat study. A chronic oral RfD of $1x10^{-2}$ mg/kg/day was extrapolated from this study based on an uncertainty factor of 3,000 (U.S. EPA, 1994).

Reproductive/Developmental Effects - No information available.

References

- U.S. EPA, 1987. Health Advisory for 25 Organic Chemicals. March 31, 1987. Office of Drinking Water. Washington, D.C.
- U.S. EPA, 1992. Integrated Risk Information System (IRIS) online database; 1,2-Dichloroethene (cis), dated 1/22/92.
- U.S. EPA, 1994. Health Effects Assessment Summary Tables, Annual FY 1994. Office of Research and Development Office of Emergency and Remedial Response, Washington, D.C., 9200.6-303(94-1).

Trichloroethene

Absorption - Trichloroethene (TCE) is readily absorbed via the lungs and gastrointestinal tract. The lungs absorb TCE at a high initial rate, and continue to absorb TCE as equilibrium is reached. Oral exposure studies in rats show that over 90% of TCE is absorbed. The rate of absorption following dermal exposure is dependent on the physical state of trichloroethene encountered; absorption of the vapor through the skin is negligible compared to the liquid, which is readily absorbed through the skin (U.S. PHS, 1988).

Distribution - Data from animal studies indicate trichloroethene accumulates in the brain, liver, lungs, and adipose tissue following either inhalation or oral exposure (U.S. PHS, 1988).

Metabolism - Although metabolic pathways for trichloroethene are not well understood, three major and one minor urinary metabolite have been identified. Specifically, absorbed trichloroethene is converted to trichloroethanol, trichloroethanol glucuronide, trichloroacetic acid, and chloral hydrate (a minor urinary metabolite) by the liver. In addition, results from animal studies indicate that metabolism may occur in the bronchi, kidneys, and lungs (U.S. PHS, 1988). TCE itself is excreted via the lungs.

Carcinogenicity - Trichloroethene was formally classified by the EPA as a group B2, probable human carcinogen. The carcinogen assessment summary has been withdrawn from IRIS and HEAST; a slope factor is currently not available on IRIS or HEAST (U.S. EPA, 1994a; 1994b).

Threshold Effects - Threshold effects observed in animals include CNS depression, increased liver weights, renal dysfunction, suppressed immune response, and inhibition of an enzyme important in heme synthesis (U.S. PHS, 1988). Oral and inhalation RfDs are currently under review (U.S. EPA, 1994a).

Reproductive/Developmental Effects - Data from studies with mice and rats indicate that only the male reproductive system is affected by trichloroethene exposure: sperm motility is reduced and the incidence of morphological abnormalities in sperm is increased. Studies with rats indicate that the following fetotoxic developmental effects may occur from exposure to trichloroethene: skeletal ossification anomalies, decreased fetal weight, and behaviors indicative of delayed development (U.S. PHS, 1988).

References

- U.S. EPA, 1994a. Integrated Risk Information System (IRIS) online database; Trichloroethene, dated 7/6/94.
- U.S. EPA, 1994b. Health Effects Assessment Summary Tables, Annual FY 1994. Office of Research and Development - Office of Emergency and Remedial Response, U.S. EPA, Washington, D.C., 9200.6-303(94-1).
- U.S. Public Health Service, 1988. Toxicological Profile for Trichloroethene

Tetrachloroethene

Absorption - Absorption of tetrachloroethene (PCE) following inhalation exposure or ingestion is rapid and nearly complete. Dermal absorption of dissolved PCE has been shown to be insignificant (U.S. PHS, 1988).

Distribution - Tetrachloroethene is primarily distributed to the adipose tissue following inhalation exposure in animals. In addition, there was some accumulation noted in the brain and liver (U.S. PHS, 1988).

Metabolism - Metabolic pathways for tetrachloroethene are different in study animals and humans. In humans, the primary metabolites found following inhalation and oral exposure are trichloroacetic acid and trichloroethanol (U.S. PHS, 1988). Oxalic acid is an important metabolite in some animals that has not been reported in humans (U.S. PHS, 1988).

Carcinogenicity - Tetrachloroethene has in the past been classified in Group B2, probable human carcinogen. A final decision on its classification as a Group B2 or C carcinogen has not yet been made; a slope factor is currently not available on IRIS or HEAST (U.S. EPA, 1992; 1994).

Threshold Effects - The chronic oral RfD determined for tetrachloroethene is 1.0 x $10^{-2} \text{ mg/kg/day}$ (U.S. EPA, 1992). This chronic RfD was derived from a subchronic study in mice with hepatotoxicity as the critical effect.

Reproductive/Developmental Effects - Little information exists concerning reproductive effects resulting from tetrachloroethene exposure. A study of mice which looked at inhalation of tetrachloroethene, observed sperm abnormalities. Additional inhalation studies in animals resulted in fetotoxic developmental effects including skeletal ossification anomalies and behavioral performance and brain neurochemistry effects (U.S. PHS, 1988).

References

U.S. EPA, 1992. Integrated Risk Information System (IRIS) online database; Tetrachloroethene. dated 4/6/92.

- U.S. EPA, 1994. Health Effects Assessment Summary Tables, Annual FY 1994. Office of Research and Development - Office of Emergency and Remedial Response, U.S. EPA, Washington, D.C., 9200.6-303(94-1).
- U.S. Public Health Service, 1988. Toxicological Profile for Tetrachloroethene.

Carbon Disulfide

Absorption - Studies indicate that carbon disulfide is readily absorbed in humans and animals following inhalation exposure. Significant absorption via the dermal route occurs in humans and animals (U.S. PHS, 1990).

Distribution - Once absorbed via inhalation, carbon disulfide is taken up by the blood and distributed throughout the body, especially to lipid-rich tissues and organs like the brain and liver. Studies regarding absorption in humans by oral exposure could not be located (U.S. PHS, 1990).

Metabolism - Proposed metabolic pathways suggest that carbon disulfide is metabolized to an unstable oxygen intermediate; which after several reactions ultimately result in the formation of a sulfate or other nonvolatile metabolite (U.S. PHS, 1990). In the liver, carbon disulfide reacts with amino acids to form thiocarbonate.

Carcinogenicity - No data is available for a carcinogenicity assessment (U.S. EPA, 1992).

Threshold Effects - Carbon disulfide affects the central nervous system, cardiovascular system, eyes, kidneys, liver and skin. A subchronic oral NOEL was found to be 11.0 mg/kg/day in a rabbit inhalation teratogenic study (U.S. EPA, 1992). Rabbits underwent inhalation exposure during the entire length of pregnancy and also 34 weeks before breeding to simulate occupational exposure. One oral study resulted in adverse effects to rabbit fetuses; fetotoxicity and fetal malformations were observed in rabbits. The chronic oral RfD of 1 x 10⁻¹ mg/kg/day was

derived by the EPA based on this study (U.S. EPA, 1992). This RfD may change in the near future pending the outcome of a further review being conducted by the RfD work group (U.S. EPA, 1992).

Reproductive/Developmental Effects - Studies indicate that exposure to carbon disulfide results in human reproductive effects such as decreased sperm count and decreased libido in men and intestinal regularities in women (U.S. PHS, 1990). These observations have been supported in animal studies (U.S. EPA, 1992). No developmental effects have been observed in the offsprings of men or women occupationally exposed to carbon disulfide.

References

U.S. EPA, 1992. Integrated Risk Information System (IRIS) online database; Carbon Disulfide, dated 1/22/92.

U.S. Public Health Service, 1990. Toxicological Profile for Carbon Disulfide.

<u>Benzene</u>

Absorption - Upon inhalation, benzene is quickly absorbed by the lung. Human data suggests that complete saturation of body tissues and fluids may require several days (U.S. PHS, 1989). Case studies suggest that upon oral ingestion, benzene is readily absorbed by humans and may be fatal at oral doses ranging from 9 to 30 grams (U.S. PHS, 1989). Benzene absorption through the skin occurs but at a rate lower than that for inhalation and ingestion exposures.

Distribution - Benzene is relatively insoluble in body fluids, and because of its high lipid solubility, it accumulates in fatty tissues. Human data indicate that following exposure, benzene is widely distributed by the blood. Target systems include the circulatory system, central nervous system, and the immune system (U.S. PHS, 1989).

Metabolism - In humans, the liver is the primary site of benzene metabolism. Evidence suggests that benzene toxicity is produced by one or more metabolites rather than by benzene itself. Conversion to benzene oxides is followed by the formation of phenol, the major metabolite (U.S. PHS, 1989).

Carcinogenicity - Based on studies showing an increased incidence of nonlymphocytic leukemia from occupational exposure and increased incidence of neoplasia in rats and mice exposed by inhalation and gavage, benzene is classified in Group A, a known human carcinogen (U.S. EPA, 1994). Human data do show a statistically significant increase in leukemias. The oral slope factor of 2.9 x 10⁻² per mg/kg/day was derived from human data for inhalation exposures (U.S. EPA, 1994).

Threshold Effects - Chronic exposure to benzene has been shown to cause a decrease in one or more of the circulating elements of the blood. Currently no RfD is available from the EPA (U.S. EPA, 1994).

Reproductive/Developmental Effects - Benzene has been demonstrated as an embryotoxic and fetotoxic compound in study animals as evidenced by increased incidents of resorption, reduced fetal weight and skeletal variations (U.S. PHS, 1989). In humans, benzene has not been identified as teratogenic.

References

- U.S. EPA, 1994. Integrated Risk Information System (IRIS) online database; Benzene, dated 2/7/94.
- U.S. Public Health Service, 1989. Toxicological Profile for Benzene.

Toluene

Absorption - Toluene is readily absorbed through the respiratory tract, less readily through the gastrointestinal tract and to an even lesser extent through the skin (U.S. PHS, 1988).

Distribution - Limited data exist concerning the distribution of toluene in human tissue. However, due to this compound's low water solubility, toluene is expected to distribute to and accumulate lipid tissue and bone marrow (U.S. PHS, 1988). Toluene administered orally or by inhalation to rats resulted in high levels in adipose tissue and bone marrow and lower concentrations in the liver and kidneys (U.S. PHS, 1988).

Metabolism - In humans and animals, approximately 60 to 70 percent of an absorbed dose of toluene is metabolized to hippuric acid, which is excreted in urine. Some toluene is excreted, unchanged, in expired air (U.S. PHS, 1988).

Carcinogenicity - Various studies have examined the carcinogenicity of toluene in mice as a result of direct dermal application and no incidence of skin or systemic tumors was demonstrated (U.S. EPA, 1994). Toluene has not been found to be mutagenic and is classified as a Group D compound by U.S. EPA (U.S. EPA, 1994).

Threshold Effects - Acute exposure to toluene, approximately 200 ppm can result in acute central nervous system (CNS) toxicity such as fatigue, headache, nausea, and confusion. Chronic exposure also affects the CNS with symptoms of ataxia (inability to coordinate body movements), tremors, impaired speech, vision, hearing, and memory (U.S. PHS, 1988). A subchronic gavage study in rats provided appropriate data from which the U.S. EPA derived an oral RfD. The chronic RfD of 2x10⁻¹ mg/kg/day (with an uncertainty factor of 1,000) for oral exposure is based on increases in liver and kidney weights in rats (U.S. EPA, 1994).

Reproductive/Developmental Effects - Exposure to toluene has resulted in a significant increase in fetal mortality, a decrease in birth weights, and an increase in cleft palates in mice (U.S. EPA, 1984).

References

U.S. EPA, 1984. Health Effects Assessment for Toluene. Office of Research and Development. Cincinnati, Ohio.

U.S. EPA, 1994. Integrated Risk Information System (IRIS) online database; Toluene, dated 4/6/94.

U.S. Public Health Service, 1988. Toxicological Profile for Toluene.

1,2-Dichlorobenzene

Absorption - No information available.

Distribution - No information available.

Metabolism - No information available.

Carcinogenicity - 1,2-Dichlorobenzene is classified in Group D due to lack of data and evidence of both negative and positive trends for carcinogenic responses in rats and mice (U.S. EPA, 1992).

Threshold Effects - Based on a 2-year gavage study in rats and mice, and a 13-week gavage study in rats and mice, where liver to body weight ratio increases were observed in the rats, a NOAEL of 120 mg/kg/day was derived (U.S. EPA, 1992). An oral uncertainty factor of 1000 was used to compensate for uncertainty in the extrapolation of dose levels from laboratory animals to humans, uncertainty in the threshold for sensitive humans, and uncertainty resulting

from the lack of studies assessing reproductive effects and adequate chronic toxicity in a second species. The chronic oral RfD was derived to be 9 x 10⁻² mg/kg/day based on the NOAEL and uncertainty factor (U.S. EPA, 1992).

Reproductive/Developmental Effects - No information available.

References

U.S. EPA, 1992. Integrated Risk Information System (IRIS) online database; 1,2-Dichlorobenzene, dated 1/22/92.

1,2-Dichloroethane

Absorption - In animal studies of 1,2-dichloroethane absorption, nearly all of the compound administered orally was absorbed, both from a corn oil vehicle and a water vehicle (U.S. EPA, 1984). Rapid pulmonary absorption has been inferred from the physical characteristics of 1,2-dichloroethane (U.S. EPA, 1984).

Distribution - Distribution of 1,2-dichloroethane is little dependent on route of administration. The compound tends to distribute into fatty tissues (U.S. EPA, 1984).

Metabolism - Lag times in the expression of toxicity to 1,2-dichloroethane suggest either that a detoxification system of conjugation with glutathione is saturable, or that an unknown activation reaction is part of the toxicology of the compound (U.S. EPA, 1984).

Carcinogenicity - The carcinogenicity of 1,2-dichloroethane was tested in one NCI-sponsored gavage study, which included rats and mice. The occurrence of forestomach squamous cell carcinomas, hemangiosarcoma (a blood vessel tumor), subcutaneous tissue fibroma, mammary adenocarcinoma, alveolar/bronchiolar adenoma, hepatocellular carcinoma, and endometrial

stromal polyps and sarcoma, in either male or female rats or mice was elevated in the high dose groups relative to controls (U.S. EPA, 1984).

Both dermal and inhalation studies failed to show a carcinogenic effect (U.S. EPA, 1984). No epidemiologic evidence of the carcinogenicity of 1,2-dichloroethane was found (U.S. EPA, 1984). The compound is classified as a Group B2 carcinogen, indicating that it is a probable human carcinogen (U.S. EPA, 1993).

Based on the induction of several tumor types in rats and mice treated by gavage, and lung papillomas in mice after topical application, EPA calculated an oral slope factor of 9.1 x 10⁻² per mg/kg/day, and a unit risk of 2.6 x 10⁻⁵ per ug/m³ for inhalation exposures (U.S. EPA, 1993).

Threshold Effects - Oral exposures to 1,2-dichloroethane have been evaluated only in laboratory animals, at various dose rates including 50 mg/kg/day. At this dose rate, mice had decreased growth rates, decreased water consumption, and depressed leukocyte counts. High mortality was observed in both rates and mice at higher dosages (U.S. EPA, 1984).

There are many reports of toxicity from repeated exposures to 1,2-dichloroethane vapor in the workplace. Most of the reports do not estimate exposure concentration; in one large study, however, it was estimated that average workday concentrations were 15 ppm. Reported symptoms and diagnoses from occupational exposures included the following: fatigue, nervousness, nausea, vomiting, diarrhea, anorexia, eye and respiratory tract irritation, epigastric pain, tender liver, gall bladder and liver disease, loss of reflexes, loss of muscle tone, tongue tremors, slowed heartbeat, and hyperthyroidism (U.S. EPA, 1984). Damage to the kidneys and adrenal glands may also occur. Few specific changes were found in inhalation studies performed on animals.

No EPA reference doses are available for evaluation of threshold effects (U.S. EPA, 1993).

References

- U.S. EPA, 1984. Health Effects Assessment for 1,2-Dichloroethane. September, 1984. EPA/540/1-86/051.
- U.S. EPA, 1993. Integrated Risk Information System (IRIS) online database; 1,2-Dichloroethane, dated 7/1/93.

Benzoic Acid

Absorption - Benzoic acid is absorbed rapidly and completely by the gastrointestinal tract (U.S. EPA. 1993). No studies were found on inhalation or dermal absorption.

Distribution - No information available.

Metabolism - No information available.

Carcinogenicity - Benzoic acid is classified in Group D due to a lack of data from human and animal studies (U.S. EPA, 1993).

Threshold Effects - The oral RfD of 4 mg/kg/day for chronic exposures is based on the human daily per capita maximum intake values for benzoic acid and sodium benzoate (U.S. EPA, 1993). In the stomach both exist in their ionized form which is readily absorbed in the gastrointestinal tract. No toxic effects have been reported (U.S. EPA, 1993). The only adverse effects documented are malaise and decreased food and water intake.

Reproductive/Developmental Effects - Sodium benzoate, which exists in the same form as benzoic acid in the gastrointestinal tract, appears to have no maternal, fetal, or teratogenic toxicity in mice, rats, hamsters, or rabbits (U.S. EPA, 1993).

References

U.S. EPA, 1993. Integrated Risk Information System (IRIS) online database; Benzoic Acid, dated 7/1/93.

Phenol

Absorption - Phenol is quickly absorbed by the inhalation, dermal, and oral route in humans and a variety of other mammalian species. Absorption of phenol from the small intestine appears to be quite rapid in the rat upon oral administration (U.S. PHS, 1988).

Distribution - In rabbits and rats, distribution of phenol occurs very rapidly and the highest concentrations are found in the liver, followed by lungs, blood, brain and spinal chord and kidney (U.S. PHS, 1988).

Metabolism - The primary urinary metabolites for phenol in mammals are as follows: phenyl glucuronide, phenyl sulfate, 1,4-dihydroxybenzene glucuronide and 1,4-dihydroxybenzene sulfate. Carbon dioxide has also been suggested as a significant phenol metabolite, especially in rabbits (U.S. PHS, 1988).

Carcinogenicity - Phenol has been classified in Group D, not classifiable as to human carcinogenicity, based on lack of human carcinogenicity data and inadequate animal data (U.S. EPA, 1992).

Threshold Effects - Exposure to phenol can result in short term effects such as burning pain in the mouth and throat, bloody diarrhea, pallor, sweating, weakness, headache and dizziness from inhalation; skin exposure may cause pain followed by numbness (U.S. EPA, 1992). A chronic oral RfD of 6 x 10⁻¹ mg/kg/day is based on the NOAEL of 60 mg/kg/day generated from an oral development gavage study performed on rats (U.S. EPA, 1992). This study indicated that phenol administered to pregnant rats at 120 mg/kg/day caused significant depression in fetal

body weights. This endpoint was selected as the critical effect. An uncertainty factor of 100 was used to compensate for inter-species extrapolation and for sensitive human populations. The derivation of an inhalation RfD has not yet been verified.

Reproductive/Developmental Effects - In rats and mice oral administration of phenol resulted in fetal toxicity (U.S. PHS, 1988). Phenol is not considered a pure teratogen in rats and mice. However, fetal weights may be affected by phenol exposure, as noted above.

References

U.S. EPA, 1992. Integrated Risk Information System (IRIS) online database; Phenol, dated 4/6/92.

U.S. Public Health Service, 1988. Toxicological Profile for Phenol.

4-Methylphenol (p-Cresol)

Absorption - The oral and inhalation absorption of 4-methylphenol is assumed because of toxicity resulting from these types of exposures. However, the quantities absorbed have not been determined (U.S. EPA, 1984).

Distribution - No information available.

Metabolism - No information available.

Carcinogenicity - 4-Methylphenol is classified in Group C (U.S. EPA, 1993). This is based on skin papillomas in mice to which a mixture of chemicals, including 4-methylphenol, was applied (U.S. EPA, 1993).

Threshold Effects - Cresol isomers, in general, are highly irritating to skin, mucous membranes, and eyes. Exposure may impair kidney and liver functions and result in CNS effects and cardiovascular problems (Clement, 1985). The subchronic and chronic oral reference doses, both $5x10^{-3}$ mg/kg/day, are based on the exposure by gavage of rabbits to 4-methylphenol and the resulting hypoactivity, respiratory distress, and death (U.S. EPA, 1994).

Reproductive/Developmental Effects - According to the Health Effects Assessment for Cresols (U.S. EPA, 1984), Lysol®, which contains cresol, has been used in several human cases as an abortifactant. Because Lysol® contains other chemical components in addition to cresol, this information does not provide strong evidence of reproductive and developmental toxicity from exposure to cresols.

References

Clement Associates, Inc., 1985. Chemical, Physical and Biological Properties of Compounds Present at Hazardous Waste Sites. Prepared for U.S. EPA.

U.S. EPA, 1984. Health Effects Assessment for 4-Methylphenol. Office of Research and Development. Cincinnati, Ohio.

U.S. EPA, 1993. Integrated Risk Information System (IRIS) online database; 4-Methylphenol, dated 8/2/93.

U.S. EPA, 1994. Health Effects Assessment Summary Tables, Annual - FY 1994. Office of Research and Development - Office of Emergency and Remedial Response, U.S. EPA, Washington, D.C., 9200.6-303 (94-1).

2-Chlorophenol

Absorption - No information available.

Distribution - No information available.

Metabolism - No information available.

Carcinogenicity - A carcinogenicity assessment is not available on IRIS (U.S. EPA, 1993).

Threshold Effects - A NOAEL of 5 mg/kg/day was derived from a subchronic rat drinking water study (U.S. EPA, 1993). There were critical reproductive effects. Rats were bred after being exposed to a range of 0 to 500 ppm of 2-chlorophenol in drinking water for 10 weeks. An increase in the conception rate and in the number of stillborns as well as a decrease in the size of the litters was observed. An uncertainty factor of 1000 was used to account for potential inter-species variability, intra-species extrapolation, and the use of subchronic data. The chronic oral RfD generated from this study is 5 x 10⁻³ mg/kg/day (U.S. EPA, 1993). No inhalation RfDs have been generated.

Reproductive/Developmental Effects - No information available.

References

U.S. EPA, 1993. Integrated Risk Information System (IRIS) online database; 2-Chlorophenol, dated 7/1/93.

Pentachlorophenol

Absorption - Absorption of pentachlorophenol has been documented as essentially complete, following oral administration in humans. Complete absorption occurs due to the non-polar nature of this compound, and the average half-life or absorption has been calculated to be approximately 1.3 hours, indicating that oral absorption of pentachlorophenol in humans is rapid (U.S. EPA, 1984). Inhalation of pentachlorophenol also results in rapid absorption.

Distribution - Analysis of human tissues and fluids revealed that the highest concentrations of pentachlorophenol occur in the liver, kidney, and brain (U.S. PHS, 1987). Lower levels were

also detected in the spleen and body fat. In rats, however, pentachlorophenol did not seem to accumulate following inhalation. Rapid clearance occurred and a high percentage of the compound was recuperated from the urine. In general, the binding of pentachlorophenol to plasma proteins plays an important role in pentachlorophenol distribution.

Metabolism - Animal and human studies indicate that pentachlorophenol is not readily metabolized, based on the high concentration of unchanged pentachlorophenol which is excreted upon administration (U.S. PHS, 1987).

Carcinogenicity - Based on sufficient evidence of carcinogenicity in animals, pentachlorophenol is classified in Group B2, a probable human carcinogen (U.S. EPA, 1993). Statistically significant increases in the incidences of multiple biologically significant tumor types were found in mice using two different preparations of pentachlorophenol in daily feed administered (U.S. EPA, 1993). In addition, a high incidence of two uncommon tumors was observed with both preparations. This classification is supported by mutagenicity data, which provide some indication that pentachlorophenol may cause chromosomal abnormalities. Human carcinogenic data is inadequate. The oral slope factor for pentachlorophenol developed by the U.S. EPA is 1.2 x 10⁻¹ per mg/kg/day (U.S. EPA, 1993). No inhalation slope factor for pentachlorophenol is available.

Threshold Effects - The chronic oral RfD for pentachlorophenol was generated from a NOAEL of 3 mg/kg/day from a study involving oral exposures of rats (U.S. EPA, 1993). Rats were administered 1 of 3 doses in a diet. At 30 mg/kg/day, reduced body weight and fetal toxicity were seen. Pigmentation of the liver and kidneys was observed at exposure levels of 10 mg/kg/day and 30 mg/kg/day. A chronic oral RfD of 3 x 10⁻² mg/kg/day was derived by the EPA based on liver and kidney pathology (U.S. EPA, 1993). An oral uncertainty factor of 100 accounts for the expected intra- and inter-species variability in the toxicity of the chemical. An inhalation RfD summary risk assessment for pentachlorophenol is under review by an EPA work group.

Reproductive/Developmental Effects - A teratogenicity study was conducted where oral administration of a high dose of pentachlorophenol resulted in delayed skull ossification in rats (U.S. PHS, 1987). In another study, pentachlorophenol fed to rats led to fetotoxic effects as well as maternal toxicity (U.S. EPA, 1984). Research indicates that pentachlorophenol apparently does not cross the placental barrier, so the observed fetotoxicity may be a reflection of maternal toxicity.

References

U.S. EPA, 1984. Health Effects Assessment for Pentachlorophenol. Office of Research and Development. Cincinnati, Ohio.

U.S. EPA, 1993. Integrated Risk Information System (IRIS) online database; Pentachlorophenol, dated 7/1/93.

U.S. Public Health Service, 1987. Toxicological Profile for Pentachlorophenol.

Diethyl phthalate

Absorption - No information available.

Distribution - No information available.

Metabolism - No information available.

Carcinogenicity - Diethyl phthalate is classified in Group D, not classifiable as a human carcinogen (U.S. EPA, 1993). There are no data available in the literature.

Threshold Effects - A NOAEL of 750 mg/kg-bw/day was developed from a 16-week rat feeding study (U.S. EPA, 1993). The critical effect was decreased growth rate, food consumption and altered organ weights. The estimated mean intakes were 0 to 3710 mg/kg/day. An uncertainty

factor of 1000 was used to account for extrapolation from subchronic to chronic exposure, inter-species variation, and sensitive human subpopulations. The chronic oral RfD generated from this study is 8 x 10⁻¹ mg/kg/day (U.S. EPA, 1993). No inhalation RfDs have been generated.

Reproductive/Developmental Effects - No information available.

References

U.S. EPA, 1993. Integrated Risk Information System (IRIS) online database; Diethylphthalate, dated 2/1/93.

Di-n-butyl Phthalate

Absorption - No information available.

Distribution - No information available.

Metabolism - No information available.

Carcinogenicity - Di-n-butyl phthalate is classified in Group D, not classifiable as a human carcinogen due to unavailable data regarding carcinogenicity (U.S. EPA, 1993).

Threshold Effects - Based on a chronic oral 52-week study on rats, a chronic oral RfD of 1 x 10⁻¹ mg/kg/day has been established (U.S. EPA, 1993). Rats were fed 125 mg/kg/day of dinbutyl phthalate in their diet, and increased mortality resulted. The oral RfD is being reconsidered by the RfD work group. An uncertainty factor of 1000 was used.

Reproductive/Developmental Effects - No information available.

References

U.S. EPA, 1993. Integrated Risk Information System (IRIS) online database; Di-n-butylphthalate, dated 2/1/93.

Butylbenzyl phthalate

Absorption - No information available.

Distribution - No information available.

Metabolism - No information available.

Carcinogenicity - Based on an NTP bioassay study resulting in a statistically significant increase in mononuclear cell leukemia in female rats, butylbenzyl phthalate is classified in Group C, as a possible human carcinogen (U.S. EPA, 1993). Studies indicate that butylbenzyl phthalate is not a direct acting mutagen in the reverse mutation assay with Salmonella typhimyrium or in Escherichia coli (U.S. EPA, 1993). A slope factor is not available on IRIS (U.S. EPA, 1993).

Threshold Effects - Based on the critical effects of significantly increased liver-to-body weight and liver-to-brain weight ratios from a six month subchronic oral rat study, a chronic oral RfD was set (U.S. EPA, 1993). This level was generated after rats were administered concentrations of either 0, 0.03, 0.09, 0.28, 0.83 or 2.5% butylbenzyl phthalate in the diet for 26 weeks. An uncertainty factor of 1000 was used to compensate for intra-species sensitivity, inter-species variability, and extrapolation from subchronic to chronic levels. The NOAEL of 159 mg/kg/day was used to derive the oral RfD at 2.0 x 10⁻¹ mg/kg/day (U.S. EPA, 1993). No data exist to derive an inhalation RfD.

 ${\bf Reproductive/Developmental\ Effects\ -\ No\ information\ available.}$

References

U.S. EPA, 1993. Integrated Risk Information System (IRIS) online database; Butylbenzyl phthalate, dated 2/1/93.

Bis(2-Ethylhexyl)phthalate

Absorption - Upon oral administration, bis(2-ethylhexyl)phthalate (DEHP) and its principal metabolites are readily absorbed from the gastrointestinal tract in animals. In rats, inhaled bis(2-ethylhexyl)phthalate is absorbed by the lung whereas dermal application to rat skin results in poor absorption of this chemical. No human data are available (U.S. PHS, 1989).

Distribution - Absorbed bis(2-ethylhexyl)phthalate is readily distributed to the organs and tissues with the liver being the principal initial repository organ (U.S. PHS, 1989). Clearance is rapid; no apparent accumulation has been observed (U.S. PHS, 1989).

Metabolism - Bis(2-ethylhexyl)phthalate is hydrolyzed to its corresponding monoester primary metabolite and subsequently an alcoholic substituent, 2-ethylhexanol, is released (U.S. PHS, 1989). The monoester metabolite and 2-ethylhexanol are quickly oxidized to a variety of more polar products.

Carcinogenicity - Based on significant dose-related increases in liver tumor responses in rats and mice, bis(2-ethylhexyl)phthalate is classified in Group B2, a probable human carcinogen (U.S. EPA, 1993). Results from human data are considered inadequate. Bis(2-ethylhexyl)phthalate has mixed results in mutagenicity assays. The oral slope factor of 1.4 x 10⁻² per mg/kg/day was generated from an NTP study using male and female rats and mice (U.S. EPA, 1993). The rats were fed diets ranging from 0 to 12,000 mg/kg/day bis(2-ethylhexyl)phthalate for 103 weeks, and the mice were given 0 to 6,000 mg/kg/day in the diet for 103 weeks. No inhalation unit risk has been derived.

Threshold Effects - A chronic oral RfD for bis(2-ethylhexyl)phthalate was generated as 2 x 10²

mg/kg/day from a LOAEL of 19 mg/kg/day in a 1-year guinea pig feeding study (U.S. EPA,

1993). The critical effect was increased relative liver weight in treated females. An uncertainty

factor of 1000 was used to compensate for inter-species variation, to protect sensitive human

subpopulations, and because the guinea pig exposure was longer than subchronic, but less than

lifetime. While the RfD is set on a LOAEL, the effect observed was considered to be minimally

adverse, so a higher uncertainty factor was not employed.

Reproductive/Developmental Effects - Studies demonstrate that DEHP is a reproductive

toxicant in mice and rats. Testicular damage and fertility reduction were observed (U.S. PHS,

1989). No human data regarding reproductive effects via inhalation, ingestion or dermal

exposure are available (U.S. PHS, 1989).

References

U.S. EPA, 1993. Integrated Risk Information System (IRIS) online database;

Bis(2-Ethylhexylphthalate), dated 2/1/93.

U.S. Public Health Service, 1989. Toxicological Profile for Bis(2-Ethylhexylphthalate).

Dibenzofuran

Absorption - No information available.

Distribution - No information available.

Metabolism - No information available.

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Carcinogenicity - Dibenzofuran has been classified in Group D because no human and animal data are available (U.S. EPA, 1992). Dibenzofuran is not known to be mutagenic (U.S. EPA, 1992).

Threshold Effects - Insufficient data exist to derive inhalation and oral RfDs (U.S. EPA, 1992).

Reproductive/Developmental Effects - No information available.

References

U.S. EPA, 1992. Integrated Risk Information System (IRIS) online database; Dibenzofuran, dated 5/1/92.

Carbazole

Absorption - No information available.

Distribution - No information available.

Metabolism - No information available.

Carcinogenicity - Carbazole has been classified in Group B2, a probable human carcinogen (U.S. EPA, 1994). An oral slope factor of 2.0 x 10⁻² per mg/kg/day was derived from a 96-week dietary study in mice, based on liver tumors (U.S. EPA, 1994). No inhalation unit risk has been determined.

Threshold Effects - No data exist to derive inhalation and oral RfDs.

Reproductive/Developmental Effects - No information available.

References

U.S. EPA, 1994. Health Effects Assessment Summary Tables, Annual FY - 1994. Office of Research and Development - Office of Emergency and Remedial Response, U.S. EPA, Washington, D.C., 9200.6-303(94-1).

Naphthalene

Naphthalene is a lightweight PAH of simple structure: two six-carbon rings sharing a side.

Absorption - Although no quantitative data are available, naphthalene is known to be absorbed following ingestion and inhalation based on the resulting toxic effects (U.S. EPA, 1984).

Distribution - No information is available.

Metabolism - A liver metabolite of naphthalene (1,2-dihydro-, 1,2-dihydroxy-naphthalane) is shown to be related to toxic ocular effects (Klaassen et al., 1986).

Carcinogenicity - The carcinogenic classification for naphthalene is Group D; not classifiable as to human carcinogenicity (U.S. EPA, 1994a).

Threshold Effects - The site of critical concern for naphthalene is the eye. Naphthalene is associated with cataracts and retina degeneration in laboratory animals. Inhalation exposure caused nausea, headache, and optic and kidney damage in humans and experimental animals (Clement, 1985). A chronic oral RfD for naphthalene is not provided on IRIS or HEAST (U.S. EPA, 1994a; 1994b).

Reproductive Effects - Naphthalene metabolites are known to cross the placenta in sufficient amounts to cause fetotoxic effects (U.S. EPA, 1984). Naphthalene retarded cranial ossification and heart development in the offspring of exposed pregnant rats (Clement, 1985).

References

- Clement Associates, 1985. Chemical, Physical and Biological Properties of Chemicals Present at Hazardous Waste Sites. Prepared for EPA.
- Klaassen, C.D., Amdur, M.O. and J. Doull (eds)., 1986. Casarett and Doull's Toxicology, Third Edition. MacMillan Publishing Company.
- U.S. EPA, 1984. Health Effects Assessment for Naphthalene. Office of Research and Development Cincinnati, Ohio.
- U.S. EPA, 1994a. Integrated Risk Information System (IRIS) online database; Naphthalene, dated 9/1/94.
- U.S. EPA, 1994b. Health Effects Assessment Summary Tables, Annual FY 1994. Office of Research and Development Office of Emergency and Remedial Response, Washington, D.C., 9200.6-303 (94-1).

2-Methylnaphthalene

No data on this compound was readily available from EPA resources.

Fluorene

Absorption - Fluorene, as a PAH, is highly lipid soluble and is expected to be readily absorbed from the GI tract (U.S. EPA, 1984).

Distribution - No information available.

Metabolism - In general, PAH metabolism by the microsomal mixed function oxidase enzyme system yields several types of reactive and potentially carcinogenic intermediates (U.S. EPA, 1984). Chemicals known to induce or inhibit this enzyme system subsequently alter the patterns of PAH metabolism and their toxic and carcinogenic properties.

Carcinogenicity - Due to a lack of human data and inadequate data from animal bioassays, fluorene has been classified in Group D (U.S. EPA, 1992).

Threshold Effects - Based on a subchronic mouse oral study, a NOAEL of 125 mg/kg/day was determined for fluorene (U.S. EPA, 1992). Mice were exposed to 0, 125, 250 or 500 mg/kg/day fluorene suspended in corn oil by gavage for 13 weeks. Critical effects observed were a significant decrease in red blood cell count, packed cell volume and hemoglobin concentration (U.S. EPA, 1992). An uncertainty factor of 3000 was derived to compensate for use of a subchronic study for chronic RfD derivation, inter- and intra-species variability, lack of adequate data in a second species and lack of reproductive or developmental data. The chronic oral RfD derived from this study is 4 x 10⁻² mg/kg/day (U.S. EPA, 1992).

Reproductive/Developmental Effects - No information available.

References

U.S. EPA, 1984. Health Effects Assessment for Fluorene. Office of Research and Development. Cincinnati, Ohio.

U.S. EPA, 1992. Integrated Risk Information System (IRIS) online database; Fluorene, dated 1/22/92.

Acenaphthene

Absorption - Acenaphthene, as a PAH, is highly lipid soluble and is expected to be readily absorbed from the GI tract (U.S. EPA, 1984).

Distribution - No information available.

Metabolism - In general, PAH metabolism by the microsomal mixed function oxidase enzyme system yields several types of reactive and potentially carcinogenic intermediates (U.S. EPA, 1984). Chemicals known to induce or inhibit this enzyme system subsequently alter the patterns of PAH metabolism, therefore their toxic and carcinogenic properties may also be altered.

Carcinogenicity - Acenaphthene is unclassified with respect to carcinogenicity (U.S. EPA, 1993).

Threshold Effects - Based on a mouse oral subchronic study, a NOAEL of 175 mg/kg/day was derived for acenaphthene. Four groups of mice were fed by gavage daily with 0, 175, 350 or 700 mg/kg/day acenaphthene for 90 days. Critical effects observed included liver weight changes accompanied by microscopic alterations and increases in cholesterol levels. An uncertainty factor of 3000 accounts for inter- and intra-species variability, the use of a subchronic study for chronic RfD derivation, lack of adequate data in a second species, and lack of reproductive or developmental data. The chronic oral RfD derived is 6 x 10⁻² mg/kg/day (U.S. EPA, 1993). No inhalation data are available to determine an inhalation RfD.

Reproductive/Developmental Effects - No information available.

References

- U.S. EPA, 1984. Health Effects Assessment for Acenaphthene. Office of Research and Development. Cincinnati, Ohio.
- U.S. EPA, 1993. Integrated Risk Information System (IRIS) online database; Acenaphthene, dated 5/3/93.

Anthracene

Absorption - Anthracene, as a PAH, is highly lipid soluble and is expected to be readily absorbed from the GI tract (U.S. EPA, 1984).

Distribution - No information available.

Metabolism - In general, PAH metabolism by the microsomal mixed function oxidase enzyme system yields several types of reactive and potentially carcinogenic intermediates (U.S. EPA, 1984). Chemicals known to induce or inhibit this enzyme system subsequently alter the patterns of PAH metabolism, therefore their toxic and carcinogenic properties may also be altered.

Carcinogenicity - Anthracene has been classified in Group D, not classifiable as to human carcinogenicity, due to lack of human data and inadequate data from animal bioassays (U.S. EPA, 1994).

Threshold Effects - A chronic oral RfD of 3 x 10⁻¹ mg/kg/day was derived for anthracene based on a subchronic toxicity study in mice (U.S. EPA, 1994). Groups of male and female mice were exposed to anthracene by gavage at doses of 0, 250, 500 and 1000 mg/kg/day for at least 90 days. No treatment-related effects were noted. The NOEL is the highest dose tested (1000 mg/kg/day). An uncertainty factor of 3000 was used, to account for inter-species extrapolation, intra-species variability, use of a subchronic study for the chronic RfD derivation, lack of reproductive or developmental data, and lack of adequate toxicity data in a second species (U.S. EPA, 1994). No inhalation RfD has been generated.

Reproductive/Developmental Effects - No information available.

References

- U.S. EPA, 1984. Health Effects Assessment for Anthracene. Office of Research and Development. Cincinnati, Ohio.
- U.S. EPA, 1994. Integrated Risk Information System (IRIS) online database; Anthracene, dated 9/1/94.

Phenanthrene

Absorption - Phenanthrene, as a PAH, is highly lipid soluble and is expected to be readily absorbed from the gastrointestinal tract after ingestion or from the lungs after inhalation, primarily by passive diffusion (U.S. EPA, 1984).

Distribution - No information available.

Metabolism - No information available.

Carcinogenicity - Phenanthrene is classified in Group D, based on no human data and inadequate data in animal studies (U.S. EPA, 1994).

Threshold Effects - Phenanthrene is known to cause phototoxic reactions when dermally applied to skin (Klaassen et al., 1986). The oral LD_{50} for mice is 700 mg/kg. A chronic oral RfD is currently not available for phenanthrene (U.S. EPA, 1994).

Reproductive/Developmental Effects - No information available.

References

- Klaassen, C.D., Amdur, M.O. and J. Doull (eds), 1986. Casarett and Doull's Toxicology. Third Edition, 1986. MacMillan Publishing Company, U.S.A.
- U.S. EPA, 1984. Health Effects Assessment for PAHs. Office of Research and Development, Cincinnati, Ohio.
- U.S. EPA, 1994. Integrated Risk Information System (IRIS) online database; Phenanthrene, dated 9/1/94.

Pyrene

Absorption - Oral administration of an aqueous suspension of pyrene was reported as poorly absorbed from the gut of male rats in one study (U.S. EPA, 1984). However, the same study concluded that rapid pulmonary absorption of a pyrene aerosol (300-500 ug/l of air) is achieved via inhalation by male rats.

Distribution - Widespread tissue distribution occurs upon inhalation of pyrene (U.S. EPA, 1984).

Metabolism - Pyrene is a PAH and, in general, PAH metabolism by the microsomal mixed function oxidase enzyme system yields several types of reactive and potentially carcinogenic intermediates (U.S. EPA, 1984). Chemicals known to induce or inhibit this enzyme system subsequently alter the patterns of PAH metabolism, therefore, their toxic and carcinogenic properties may also be altered.

Carcinogenicity - Pyrene is classified in Group D due to lack of human data, inadequate data from animal bioassays, and mixed results from mutagenicity data (U.S. EPA, 1994).

Threshold Effects - Based on a study involving the subchronic exposure of mice, a NOAEL of 75 mg/kg/day for pyrene was established (U.S. EPA, 1994). Critical effects observed were kidney effects, including nephropathy and reduced kidney weight. An uncertainty factor of 3000 was established to reflect potential intra- and inter-species variability, the use of a subchronic study for chronic RfD derivation, the lack of toxicity studies in a second species, and lack of developmental or reproductive studies. The chronic oral RfD was determined to be 3×10^{-2} mg/kg/day based on the NOAEL and the uncertainty factor (U.S. EPA, 1994). No inhalation RfD has been derived.

Reproductive/Developmental Effects - No information available.

References

U.S. EPA, 1984. Health Effects Assessment for Pyrene. Office of Research and Development. Cincinnati, Ohio.

U.S. EPA, 1994. Integrated Risk Information System (IRIS) online database; Pyrene, dated 9/1/94.

Fluoranthene

Absorption - Fluoranthene, as a PAH, is highly lipid soluble and is expected to be readily absorbed from the GI tract (U.S. EPA, 1984).

Distribution - No information available.

Metabolism - In general, PAH metabolism by the microsomal mixed function oxidase enzyme system yields several types of reactive and potentially carcinogenic intermediates (U.S. EPA, 1984). Chemicals known to induce or inhibit this enzyme system subsequently alter the patterns of PAH metabolism; therefore, their toxic and carcinogenic properties may also be altered.

Carcinogenicity - Fluoranthene is classified in Group D based on lack of human data, deficient animal data, and ambiguous mutagenicity data (U.S. EPA, 1994).

Threshold Effects - Based on a 13-week, subchronic study involving the oral exposure of mice, a NOAEL of 125 mg/kg/day was established for fluoranthene (U.S. EPA, 1994). Critical effects observed were increased liver weight, nephropathy, and hematological alterations. An uncertainty factor of 3000 was used to compensate for potential inter-species differences, intraspecies variability, use of a subchronic study to generate a chronic RfD, lack of supporting reproductive or developmental toxicity data, and lack of toxicity data in a second species. The chronic oral RfD established from this study is 4 x 10⁻² mg/kg/day (U.S. EPA, 1994). No inhalation RfD has been generated.

Reproductive/Developmental Effects - No information available.

References

- U.S. EPA, 1984. Health Effects Assessment for Fluoranthene. Office of Research and Development. Cincinnati, Ohio.
- U.S. EPA, 1994. Integrated Risk Information System (IRIS) online database; Fluoranthene, dated 9/1/94.

Benzo(a)anthracene

Absorption - Benzo(a)anthracene is readily absorbed by oral and dermal routes, as evidenced in rat and mouse studies. In one study, levels of this PAH compound reached a maximum in the blood, liver and brain only 1 to 2 hours after oral administration (U.S. PHS, 1990). Quantitative information on absorption via the respiratory tract is not available, but uptake has been determined to be dependent on the blood perfusion rate of the affected tissue.

Distribution - Due to rapid absorption via oral exposure, this PAH is rapidly distributed among several body tissues including liver, blood, and brain, and slowly distributed in mammary and adipose tissues, where it tends to accumulate (U.S. PHS, 1990).

Metabolism - Metabolism in animals and humans is very similar to the benzo(a)pyrene biotransformation pathways. Primary biotransformations include the oxidation of the aromatic nucleus to form arene oxides, dihydrodiols, and diol epoxides (U.S. PHS, 1990). These resulting intermediates are responsible for the toxic action and carcinogenic effects of benzo(a)anthracene. These metabolites are then excreted predominantly in the feces, as is characteristic of all PAHs (U.S. PHS, 1990).

Carcinogenicity - Benzo(a)anthracene has been classified in Group B2 as a possible human carcinogen (U.S. EPA, 1994). Although human data are lacking, there are sufficient data from

animal bioassays to classify benzo(a)anthracene in Group B2. Tumors were produced in mice exposed by gavage; intraperitoneal, subcutaneous or intramuscular injections; and topical application. Mutations in bacteria and in mammalian cells have been produced. No slope factor is provided for benzo(a)anthracene (U.S. EPA, 1994).

Threshold Effects - An oral RfD has not been established by EPA for benzo(a)anthracene.

Reproductive/Developmental Effects - No information was located.

References

U.S. EPA, 1994. Integrated Risk Information System (IRIS) online database; Benz(a)anthracene, dated 9/1/94.

U.S. Public Health Service, 1990. Toxicological Profile for Benz(a)anthracene.

Chrysene

Absorption - Absorption of chrysene occurs principally via the gastrointestinal tract and also through the skin. No quantitative data on the absorption of chrysene by inhalation exists (U.S. PHS, 1990).

Distribution - One study using rats found that orally absorbed chrysene is distributed to adipose, mammary, brain, liver, and blood tissues, but preferentially accumulates in the adipose and mammary tissues (U.S. PHS, 1990).

Metabolism - Metabolism of chrysene in humans and animals parallels the biotransformation pathways described for benzo(a)pyrene (U.S. PHS, 1990). Chrysene is metabolized to reactive derivatives which are believed to be responsible for its carcinogenic nature.

Carcinogenicity - Chrysene has been classified in Group B2, as a probable human carcinogen (U.S. EPA, 1994). Although no human data are available, sufficient data from animal bioassays exist to establish this classification (U.S. EPA, 1994). Chrysene produced liver and lung tumors and malignant lymphoma in mice after intraperitoneal injection and skin carcinomas in mice following dermal exposure. Chromosomal abnormalities in hamster and mouse germ cells were produced after gavage exposure to chrysene; also, chrysene produced positive responses in bacterial gene mutation assays (U.S. EPA, 1994). No slope factor has been established for chrysene (U.S. EPA, 1994).

Threshold Effects - An oral RfD has not been established by EPA for chrysene.

Reproductive/Developmental Effects - No information available.

References

U.S. EPA, 1994. Integrated Risk Information System (IRIS) online database; Chrysene, dated 3/2/94.

U.S. Public Health Service, 1990. Toxicological Profile for Chrysene.

Benzo(b)fluoranthene

Absorption - Absorption of benzo(b)fluoranthene through the lungs and skin is expected to be similar to that of benzo(a)pyrene, which is readily absorbed by both these routes (U.S. PHS, 1990).

Distribution - No information available.

Metabolism - The pathways of benzo(b)fluoranthene metabolism in the liver have been extensively investigated. Insoluble metabolites can be classified as dihydrodiols and phenols.

Subsequent hepato-biliary excretion results in elimination of dihydrodiol and phenol and glutathione conjugates in the feces (U.S. PHS, 1990).

Carcinogenicity - Benzo(b)fluoranthene is classified in Group B2, as a probable human carcinogen (U.S. EPA, 1994). Although no human data are available, sufficient data from animal bioassays exist to establish this classification. Benzo(b)fluoranthene produced tumors in mice after lung implantation, intraperitoneal or subcutaneous injection, and skin painting. No slope factor has been established for benzo(b)fluoranthene (U.S. EPA, 1994).

Threshold Effects - An oral RfD has not been established by EPA for benzo(b)fluoranthene.

Reproductive/Developmental Effects - No information available.

References

U.S. EPA, 1994. Integrated Risk Information System (IRIS) online database; Benzo(b)fluoranthene, dated 3/2/94.

U.S. Public Health Service, 1990. Toxicological Profile for Benzo(b)fluoranthene.

Benzo(a)pyrene

Absorption - Benzo(a)pyrene is readily absorbed through the respiratory tract, the gastrointestinal tract, and the skin (U.S. PHS, 1987). This information is primarily based on data obtained from animal studies.

Distribution - After absorption, benzo(a)pyrene is rapidly distributed to and absorbed by several tissues, including the esophagus, intestines, kidneys, liver, lungs and stomach (U.S. PHS, 1987). This information is based on data from inhalation studies conducted with rats.

Metabolism - The pathways of benzo(a)pyrene metabolism are well described, based on results of human and animal studies. This PAH is metabolized to varying degrees by several tissues including the kidneys, liver, and lungs, as well as other tissues of the respiratory and gastrointestinal tracts. The first metabolic phase results in the formation of arene oxides and phenols. Subsequent reactions produce quinones, dihydrodiols, phenol-diols, and diol epoxides, which may hydrolyze to tetrols. These compounds may then form conjugates with glutathione, sulfate, or glucuronic acids to form Phase III metabolites, which are eliminated in the feces following hepato-biliary excretion (U.S. PHS, 1987).

Carcinogenicity - Benzo(a)pyrene has been classified in Group B2, as a possible human carcinogen (U.S. EPA, 1994). Studies in rodents and other species demonstrate benzo(a)pyrene to be carcinogenic following exposure by oral, intratracheal, inhalation, and dermal routes. Oral administration of benzo(a)pyrene has induced stomach tumors, lung tumors, and leukemia in experimental animals, while inhalation exposures have induced nasal, tracheal, pharyngeal, and upper digestive tumors. Dermal administration of benzo(a)pyrene has induced skin tumors. Benzo(a)pyrene has produced positive results in several in vitro bacterial and mammalian genetic toxicology assays (U.S. EPA, 1994).

Human data specifically linking benzo(a)pyrene to a carcinogenic effect are lacking. Lung cancer has been shown to be induced in humans by various mixtures of polycyclic aromatic hydrocarbons known to contain benzo(a)pyrene. It is not possible, however, to conclude from this information that benzo(a)pyrene is the responsible agent. The current oral slope factor for benzo(a)pyrene is 7.3 per mg/kg/day (U.S. EPA, 1994) and was calculated as the geometrical mean of a range of slope factors between 4.5 and 11.7 per mg/kg/day.

Threshold Effects - There is no EPA approved chronic oral RfD for benzo(a)pyrene.

Reproductive/Developmental Effects - No data are available on the reproductive and developmental effects of benzo(a)pyrene on humans. However, studies with mice involving oral exposures indicate that decreased fertility and progeny sterility may constitute reproductive

effects expected in humans (U.S. PHS, 1987). Potential developmental effects include low birth weight, stillbirth, resorption, and malformations (U.S. PHS, 1987).

References

U.S. EPA, 1994. Integrated Risk Information System (IRIS) online database; Benzo(a)pyrene, dated 7/6/94.

U.S. Public Health Service, 1987. Toxicological Profile for Benzo(a)pyrene.

Benzo(k)fluoranthene

Absorption - Benzo(k)fluoranthene, as a PAH, is highly lipid soluble and is expected to be readily absorbed from the GI tract (U.S. EPA, 1984).

Distribution - No information available.

Metabolism - In general, PAH metabolism by the microsomal mixed function oxidase enzyme system yields several types of reactive and potentially carcinogenic intermediates (U.S. EPA, 1984). Chemicals known to induce or inhibit this enzyme system subsequently alter the patterns of PAH metabolism, therefore their toxic and carcinogenic properties may also be altered.

Carcinogenicity - Benzo(k)fluoranthene has been classified in Group B2, as a probable human carcinogen, due to sufficient data from animal bioassays (U.S. EPA, 1994). Although there are no human data that specifically link exposure to benzo(k)fluoranthene to human cancers, benzo(k)fluoranthene is a component of mixtures that have been associated with human cancer (U.S. EPA, 1994). No slope factor has been established for benzo(k)fluoranthene (U.S. EPA, 1994).

Threshold Effects - No chronic oral RfD has been established by EPA.

Reproductive/Developmental Effects - No information available.

References

U.S. EPA, 1984. Health Effects Assessment for Benzo(k)fluoranthene. Office of Research and Development. Cincinnati, Ohio.

U.S. EPA, 1994. Integrated Risk Information System (IRIS) online database; Benzo(k)fluoranthene, dated 3/2/94.

Indeno(1,2,3-cd)pyrene

Absorption - No information available.

Distribution - No information available.

Metabolism - No information available.

Carcinogenicity - Indeno(1,2,3-cd)pyrene is classified in Group B2, as a probable human carcinogen, based on sufficient data from animal bioassays (U.S. EPA, 1994). No slope factor has been established for indeno(1,2,3-cd)pyrene (U.S. EPA, 1994).

Threshold Effects - A chronic oral RfD has not been established by EPA for indeno(1,2,3-cd)pyrene.

Reproductive/Developmental Effects - No information available.

References

U.S. EPA, 1994. Integrated Risk Information System (IRIS) online database; Indeno(1,2,3-cd)pyrene, dated 3/2/94.

Benzo(g,h,i)perylene

Absorption - Benzo(g,h,i)perylene, as a PAH, is highly lipid soluble and is expected to be readily absorbed from the GI tract (U.S. EPA, 1984).

Distribution - No information available.

Metabolism - In general, PAH metabolism by the microsomal mixed function oxidase enzyme system yields several types of reactive and potentially carcinogenic intermediates (U.S. EPA, 1984). Chemicals known to induce or inhibit this enzyme system subsequently alter the patterns of PAH metabolism, therefore, their toxic and carcinogenic properties may also be altered.

Carcinogenicity - Benzo(g,h,i)perylene has been classified in Group D, not classifiable as to human carcinogenicity (U.S. EPA, 1992). No human data are available, and animal data from animal bioassays are inadequate to establish a positive classification as a carcinogen.

Threshold Effects - A chronic oral RfD has not been established by EPA for benzo(g,h,i)perylene.

Reproductive/Developmental Effects - No information available.

References

- U.S. EPA, 1984. Health Effects Assessment for Benzo(g,h,i)perylene. Office of Research and Development. Cincinnati, Ohio.
- U.S. EPA, 1992. Integrated Risk Information System (IRIS) online database; Benzo(g,h,i)perylene, dated 1/22/92.

Dibenzo(a,h)anthracene

Absorption - Animal studies indicate that dibenzo(a,h)anthracene is absorbed by the oral route of exposure, while dermal absorption occurs very slowly. Inhalation absorption has not been investigated (U.S. PHS, 1990).

Distribution - Absorbed dibenzo(a,h)anthracene is generally distributed to several tissues with relative uptake dependent on the blood perfusion rate of the tissue. Initially, concentrations are higher in the liver and kidney. It is persistent in the ovaries and adipose tissue (U.S. PHS, 1990).

Metabolism - Dibenzo(a,h)anthracene is metabolized more slowly than PAHs of lower molecular weight (U.S. PHS, 1990). The principal metabolic intermediates formed include arene oxides, phenols, dihydrodiols, and a dio-epoxide. Dibenzo(a,h)anthracene is primarily excreted in the feces (U.S. PHS, 1990).

Carcinogenicity - Dibenzo(a,h)anthracene has been classified in Group B2, a probable human carcinogen, based on sufficient data from animal bioassays (U.S. EPA, 1994). Carcinomas have been observed in mice following oral or dermal exposure and injection site tumors have been observed following subcutaneous or intramuscular administration of dibenzo(a,h)anthracene. DNA damage and gene mutations in bacteria as well as gene mutations and transformation in several types of mammalian cell cultures have been induced by dibenzo(a,h)anthracene. No slope factor has been established (U.S. EPA, 1994).

Threshold Effects - No chronic oral RfD has been established by EPA for dibenzo(a,h)anthracene.

Reproductive/Developmental Effects - Data regarding reproductive or developmental effects in humans or experimental animals could not be located in the available literature.

References

- U.S. EPA, 1994. Integrated Risk Information System (IRIS) online database; Dibenzo(a,h)anthracene, dated 3/2/94.
- U.S. Public Health Service, 1990. Toxicological Profile for Dibenzo(a,h)anthracene.

Lindane (gamma BHC) (Gamma-Hexachloro cyclohexane)

Absorption - The unusually high solubility of Lindane in water, compared with other organochlorine pesticides, contributes to its rapid absorption. Lindane is readily absorbed by the body following inhalation, oral, and dermal exposures. High blood concentrations have been observed following a number of acute poisoning cases (U.S. PHS, 1989). The average absorption of Lindane following administered doses in feed was 99.4% (U.S. PHS, 1989). The ready absorption of Lindane through human skin has been demonstrated with topical lotion applications. Studies involving topical application of Lindane to the forearm indicate rapid absorption of at least 97% of the applied does with maximum absorption occurring 2 to 3 days after application (U.S. PHS, 1989).

Distribution - Following inhalation exposure to Lindane in the workplace, air concentrations of 0.004 to 0.15 mg/m³ were associated with blood serum levels in workers of 0.7 ug/L. HCH isomers have also been detected in adipose tissue following inhalation exposure (U.S. PHS, 1989). Studies of human poisonings indicate that Lindane is partly distributed to the central nervous system following both oral and dermal exposures. Animal studies have shown that Lindane is primarily stored in the fat tissue of rats following oral administration (U.S. PHS, 1989).

Metabolism - The metabolism and subsequent detoxification of Lindane appears to be dependent on the P450 oxidative system. The metabolism in rats and mice is similar to that in humans. Researchers have determined that chlorophenols and chlorbenzenes are the primary metabolites

of Lindane and are excreted primarily in the urine, and also in milk and semen (U.S. PHS, 1989).

Carcinogenicity - Lindane is classified in Group B2-C (U.S. EPA, 1994), indicating that the evidence supports classification of Lindane either as a probable or a possible human carcinogen. The oral slope factor is 1.3 per mg/kg/day (U.S. EPA, 1994). The oral slope factor is based on the occurrence of liver tumors in mice following exposure to Lindane in the diet.

Threshold Effects - Based on a chronic oral study in rats, a chronic oral RfD of $3x10^{-4}$ mg/kg/day was derived (U.S. EPA, 1992). Rats were administered 0.29 to 0.33 mg/kg/day of Lindane in their diet. The RfD is based on a critical effect of liver and kidney toxicity. An uncertainty factor of 1,000 was used (U.S. EPA, 1992).

Reproductive/Developmental Effects - No studies were located regarding reproductive or developmental effects in humans following oral exposure to Lindane. Lindane has not been reported to cause developmental effects in animals (U.S. PHS, 1989). Oral exposure to Lindane has been reported to be associated with adverse reproductive effects in rats which include increased weight and atrophy of the ovary and uterus in females and degeneration of seminiferous tubules and disruption of spermatogenesis in males (U.S. PHS, 1989).

References

- U.S. EPA, 1992. Integrated Risk Information System (IRIS) online database; Lindane, dated 7/6/92.
- U.S. EPA, 1994. Health Effects Assessment Summary Tables, Annual FY-1994. Office of Research and Development - Office of Emergency and Remedial Response, Washington, D.C., 9200.6-303 (94-1).
- U.S. PHS, 1989. Draft Toxicological Profile for Gamma-Hexachlorocyclohexane.

Endosulfan

Endosulfan is a pesticide used to control insects on grains, fruits, vegetables, tobacco, and cotton. Endosulfan exists as the alpha and beta isomeric forms. Endosulfan rapidly breaks down in water and air, but may be more persistent in soils.

Absorption - Indirect evidence from occupational poisonings suggests that endosulfan may be absorbed through the lungs. Animal studies with radiolabelled endosulfan indicate that close to 90% of an oral dose of endosulfan may be absorbed. There is also evidence from animal studies that endosulfan may be absorbed dermally (U.S. PHS, 1991).

Distribution - Following acute oral exposures to endosulfan, isomers of the parent compound and the metabolite, endosulfan sulfate, were found in blood, liver, kidney, brain, and fat. Gavage and feeding studies indicate that endosulfan is initially distributed to fatty tissues, with an accumulation in the kidneys after prolonged exposure (U.S. PHS, 1991).

Metabolism and Excretion - Endosulfan exists as two isomeric forms which are quickly metabolized in the liver to yield endosulfan sulfate and endosulfan diol. Endosulfan sulfate is believed to have toxic properties similar to the parent compound. Endosulfan sulfate and endosulfan diol can be further metabolized to endosulfan lactone, hydroxyether, and ether. Endosulfan may be excreted as both the parent compound and metabolites in feces and urine. Small doses may be completely eliminated within several days. There is some evidence that endosulfan may induce Cytochrome P-450 enzyme activity (U.S. PHS, 1991).

Carcinogenicity - There is no evidence associating endosulfan with cancers in humans. Chronic studies in which endosulfan was administered to mice and rats have provided either negative or inconclusive results regarding carcinogenic activity. However, endosulfan has produced both positive and negative results in <u>in vitro</u> mutagenicity tests (U.S. PHS, 1991). A carcinogenic classification for endosulfan has not been established by EPA.

Threshold Effects - Relatively large ingested doses of endosulfan have been fatal to both animals and humans. In animal studies, changes in liver function appeared to be associated with enzyme induction and may interfere with oxidative phosphorylation. Studies with rats indicate that humoral and cellular immune responses were depressed by oral doses of endosulfan that did not produce any other signs of toxicity. The primary target organ for endosulfan is the nervous system. Acute ingestion of large doses of endosulfan may interfere with various neurotransmitters in the brain and peripheral nervous system resulting in hyperactivity, tumors, decreased respiration, salivation, and convulsions (U.S. PHS, 1991). The U.S. EPA has developed a chronic oral RfD for endosulfan of 6x10⁻³ mg/kg/day (U.S. EPA, 1994); decreased weight gain, kidney effects, and aneurysms are listed as the critical effects.

Reproductive/Developmental Effects - Feeding studies in rats suggest that endosulfan produces maternal and fetal toxicity at 5 mg endosulfan/kg/day and doses of 0.66 mg endosulfan/kg/day were teratogenic. Neonatal rats treated with 1 mg endosulfan/kg/day for 5 weeks displayed behavioral abnormalities. Although limited reproductive studies with rodents have been negative, adverse effects on reproductive organs have been reported in male rabbits and female rats (U.S. PHS, 1991).

References

- U.S. EPA, 1994. Health Effects Assessment Summary Tables, Annual FY-1994. Office of Research and Development, Office of Emergency and Remedial Response, Washington, D.C., 9200.6-303(94-1).
- U.S. Public Health Service (PHS), 1991. Draft Toxicological Profile for Endosulfan, Endosulfan Alpha, Endosulfan Beta, Endosulfan Sulfate.

DDT

DDT (specifically, 4,4'-dichlorodiphenyltrichloroethane, also known as 4,4'-DDT or p,p'-DDT) is a solid. Technical DDT is generally a mixture of 4,4'-DDT, 4,4'-DDD, and traces of other

materials. DDD and DDE are metabolites or degradation products that are often identified as environmental contaminants.

DDT is the best known of all the synthetic insecticides. This compound was synthesized in 1874. Its insecticidal effectiveness was discovered in 1939 and it was patented in 1942. During World War II, DDT was directly applied to humans for the control of lice and other insects. It was one of the most widely used agricultural insecticides in the United States and other countries from 1946 to 1972 (Klaassen et al., 1986).

Distribution - Chronic exposures to DDT, DDD and DDE in humans lead to accumulation of the chemical in fatty tissues. DDT's location of primary toxic action is the sensory, motor nerve fibers and the motor cortex (Klaassen et al., 1986).

Metabolism - Metabolites of DDT include 4,4'-DDE and 2,4'-DDD. DDT isomers and metabolites are often found together and have similar properties (Clement Associates, 1985).

Carcinogenicity - There is evidence of carcinogenicity in animals with exposures to DDT. Exposures to DDT and its metabolites have lead to liver tumors in mice (U.S. EPA, 1984). Exposures to DDT have also resulted in hepatomas in rats and lymphomas and lung cancers in mice. DDT is classified in Group B2, probable human carcinogen, by the U.S. EPA (U.S. EPA, 1992). EPA has derived an oral slope factor of 0.34 per mg/kg/day and an inhalation unit risk of $9.7x10^{-5}$ per μ g/m³ (U.S. EPA, 1992).

Threshold Effects - While DDT is classified as a neuropoison, no unequivocal reports of fatal human poisoning have been recorded despite widespread use of the substance for 30 to 40 years (Klaassen et al., 1986). A dose of 200 mg/kg of DDT has been determined to be highly dangerous though not fatal to humans (Sax, 1987).

Most toxicological data are based on oral exposures. Acute oral exposures can lead to symptoms of burning or prickling sensations of the tongue, lips and face, apprehension, irritability,

dizziness and tremors (Klaassen et al., 1986). Chronic oral exposures resulted in liver lesions at all doses tested, the lowest of which was 10 ppm in food or 0.5 mg/kg/day. Additional animal studies showed increased incidence of tumors and increased mortality of offspring in a six generation study with an exposure of 100 ppm (13 mg/kg/day).

DDT and its metabolites are compounds with a capacity to bioconcentrate, typically in the adipose issues of most animals. Toxic doses produce vomiting, muscle weakness, disturbance of equilibrium, and finally chronic or asphyxial convulsions, followed by death from respiratory failure or ventribular fibrillation (Clayton and Clayton, 1982). The chronic oral RfD of 5.0×10^4 mg/kg/day was derived from a study of rats fed commercial grade DDT, where hepatocellular hypertrophy were observed at some doses, and a NOEL was shown to be 0.05 mg/kg/day (U.S. EPA, 1992). Liver lesions was cited as the critical effect.

Reproductive Effects - Oral exposures of 2.5 mg/kg/day of DDT ingested by pregnant mice proved embryotoxic and fetotoxic (U.S. EPA, 1984). DDT has consistently caused a decrease in the reproductive capacity of organisms tested.

References

- Clayton and Clayton, 1982. Patty's Industrial Hygiene and Toxicology. Volume IIC Toxicology. Third Revised Edition.
- Clement Associates, Inc., 1985. Chemical, Physical and Biological Properties of Compounds Present at Hazardous Waste Sites. Prepared for U.S. EPA.
- Klaassen, C.D., Amdur, M.O. and J. Doull (eds.), 1986. Casarett and Doull's Toxicology, Third Edition. MacMillan Publishing Company, U.S.A.
- Sax, N.I., R.J. Lewis Sr., 1987. Hazardous Chemicals Desk Reference. New York.
- U.S. EPA, 1984. Health Effects Assessment for DDT. Office of Research and Development, Cincinnati, Ohio.
- U.S. EPA, 1992. Integrated Risk Information System (IRIS) online database; DDT, dated 2/12/92.

Methoxychlor

Absorption - Although not quantified, methoxychlor is known to be absorbed via ingestion and dermal contact based on resulting toxic effects. Depending on routes of exposure, anywhere from 60 to 98 percent for an administered dose may be excreted within 24 hours (U.S. EPA, 1987).

Distribution - Studies indicate that after being absorbed, methoxychlor quickly moves to the liver, but it is not readily accumulated in the liver, fat, brain, or heart (U.S. EPA, 1987).

Metabolism - When female swiss mice were orally dosed with methoxychlor, the major metabolites detected were the monophenol and bisphenol of methoxychlor. <u>In vitro</u> studies of methoxychlor metabolism detected formaldehyde in addition to the monophenol and bisphenol metabolities (U.S. EPA, 1987).

Carcinogenicity - Methoxychlor is classified in Group D, not classified as to human carcinogenicity (U.S. EPA, 1993).

Threshold Effects - The oral RfD derived for methoxychlor is $5x10^{-3}$ mg/kg/day (U.S. EPA, 1993). This RfD is based on a NOAEL of 5.01 mg/kg/day, fed to female rats during gestation. The critical effect listed is excessive loss of litters (U.S. EPA, 1993). This same RfD value is given for subchronic exposures, but no information is available on inhalation RfDs.

Reproductive/Developmental Effects - No evidence is available for reproductive effects. Fetotoxicity was, however, the critical effect used to establish the RfD (U.S. EPA, 1993).

References

- U.S. EPA, 1987. Health Advisories for the Pesticides. Office of Drinking Water, Washington, D.C.
- U.S. EPA, 1993. Integrated Risk Information System (IRIS) online database; Methoxychlor, dated 12/1/93.

Chlordane

Absorption - Chlordane may enter the body through the skin, lungs, or gastrointestinal tract. Excretion via urine and feces is limited. Uptake through the skin and GI tract is facilitated if the chlordane is dissolved in an oily substance. Absorption following inhalation is rapid (U.S. PHS, 1989).

Distribution - Chlordane is distributed throughout the body largely to organs, such as the brain and liver, and to fat tissue. However, distribution to the liver and kidneys has been shown to be more rapid than to fat (U.S. PHS, 1989).

Metabolism - The following metabolites were found, in decreasing order, during an assay using a human liver microsound preparation: chlordane chlorohydrin, monohydroxylated dihydrochlordane, oxychlordane, and a number of other chlor-, hydroxy-, and epoxy-chlordenes (U.S. PHS, 1989).

Carcinogenicity - Based on increased liver cancer in male and female mice and the structural similarities between chlordane and other liver carcinogens, chlordane is classified B2, as a probable human carcinogen (U.S. EPA, 1993). Human data do not show a statistically significant increase in cancer mortality. Chlordane has had mixed results in mutagenicity assays. The oral slope factor of 1.3 per mg/kg/day was derived using the geometric means from the four mouse data sets in which liver cancer was the predominant result (U.S. EPA, 1993). One study by Velsicol Chemical Corporation involved the feeding exposure to male and female CD-1 mice

where concentrations ranged from 0 to 50 ppm. The NCI feeding study used B6C3F1 male and female mice with doses ranging from 29.9 to 63.8 ppm. The inhalation slope factor, 1.3 per mg/kg/day, or $3.7x10^{-4}$ per ug/m³, was derived from the oral slope factor and is not considered valid above 30 ug/m³ (U.S. EPA, 1993).

Threshold Effects - The target organs for chlordane once it has entered the body are the central nervous system (CNS), the digestive system, and liver. The chronic oral RfD for chlordane was generated from the NOEL of 0.055 mg/kg/day in a 30 month rat feeding study (U.S. EPA, 1993). The critical effect was liver hypertrophy in female rats. Doses ranged from 0.045 to 1.409 mg/kg/day. An uncertainty factor of 1000 was used to compensate for inter- and intraspecies differences as well as inadequate reproductive data (U.S. EPA, 1993). The chronic oral RfD generated is 6x10⁻⁵ mg/kg/day. No inhalation RfDs have been generated.

Reproduction Effects - Results from studies on the reproductive toxicity of chlordane show mixed results. There are no data for humans. Some studies indicate testicular toxicity, while others indicate none (U.S. PHS, 1989).

References

U.S. EPA, 1993. Integrated Risk Information System (IRIS) online database; Chlordane, dated 7/1/93.

U.S. PHS, 1989. Draft Toxicological Profile for Chlordane.

Polychlorinated Biphenyls (PCBs)

Absorption - PCBs are readily absorbed via inhalation and are also absorbed via ingestion and dermal contact. This is illustrated by blood PCB levels and toxic effects from various routes of exposure (U.S. PHS, 1987).

Distribution - Studies indicate that PCB distribution occurs in a two-fold manner. First, PCBs move from the blood to the liver and muscles. Much of this PCB is then stored in fat tissue where it remains for long periods of time (U.S. PHS, 1987).

Metabolism - Phenolic compounds are the primary products of PCB metabolism although sulfur-containing metabolites, trans-dihydrodiols, polyhydroylated PCBs, and methy ether derivatives have also been identified. As the chlorination increases on both phenyl rings, the rate of metabolism decreases. A large amount of variation has been found in the metabolism of different PCB isomers and in different species (U.S. PHS, 1987).

Carcinogenicity - PCBs are classified as B2, probable human carcinogens (U.S. EPA, 1994). Although human data are inadequate, liver cancer resulted in three strains of rats and two strains of mice. The oral slope factor, 7.7 per mg/kg/day, is based on a study in which Sprague-Dawley rats were fed a diet including Aroclor 1260 for 24 months (U.S. EPA, 1994). Surviving females showed a 91 percent incidence of liver cancer. No inhalation slope factor has been generated (U.S. EPA, 1994).

Threshold Effects - PCB exposure can result in liver toxicity as is evident from both human and animal exposures including rats, mice, guinea pigs, rabbits, dogs, and monkeys. Some liver effects seen are enzyme induction, liver enlargement, fat deposition, and necrosis (U.S. PHS, 1987). RfDs are becoming available from EPA for specific Aroclors. No chronic oral RfD is available for PCBs as a group or specifically Aroclor 1260 (U.S. EPA, 1994).

Reproductive/Developmental Effects - A study on mink resulted in total reproductive inhibition at a diet of 15 mg/kg/day. Rats have exhibited fetal mortality, reduced litter size, and lengthened menstrual cycles (U.S. PHS, 1987).

References

U.S. EPA, 1994. Integrated Risk Information System (IRIS) online database; Polychlorinated Biphenyls (PCBs), dated 6/1/94.

U.S. Public Health Service, 1987. Toxicological Profile for PCBs.

Aluminum

Absorption - Occupational studies regarding aluminum absorption in humans determined that following a 1-day exposure (8 hour work shift) to a time weight concentration of 2.4 mg/m³ aluminum, aluminum levels rapidly increased in the urine (U.S. PHS, 1990). Human and animal studies indicate that absorption readily occurs following inhalation and ingestion exposure to aluminum. However, absorption via the oral route is very dependent on its chemical form.

Distribution - Aluminum distribution normally occurs in human body tissues and the total body burden in healthy human subjects ranges from 30 to 50 mg (U.S. PHS, 1990). Of the total body burden, about one-half is in the skeleton and approximately one-fourth is in the lungs (U.S. PHS, 1990). Evidence indicates that, with an increase in age, aluminum concentrations increase in the lungs, liver, kidneys, and brain tissue of humans.

Metabolism - Aluminum is an element; therefore, it cannot be destroyed in the body. Aluminum is found in four different forms in the body: as a free ion, as a low molecular weight complex, as a reversible macromolecular complex and as an irreversible macromolecular complex (U.S. PHS, 1990).

Carcinogenicity - Data are inadequate for a carcinogenic assessment (U.S. EPA, 1994).

Threshold Effects - No chronic oral RfD has been established by EPA for aluminum (U.S. EPA, 1994). Studies indicate that in human infants, excessive aluminum accumulation and

encephalopathy may occur, especially in premature infants with reduced renal function given dialysis with aluminum-contaminated intravenous fluid (U.S. PHS, 1990). Bone disease has been reported in those infants with renal failure who were treated with aluminum hydroxide.

Reproductive/Developmental Effects - There is no evidence from several studies that aluminum alters human of animal reproductive capabilities.

References

- U.S. EPA, 1994. Integrated Risk Information System (IRIS) online database; Aluminum, dated 9/1/94.
- U.S. Public Health Service, 1990. Toxicological Profile for Aluminum.

Arsenic

Absorption - Soluble inorganic arsenic compounds are extensively absorbed by humans and other animals, following ingestion. Less soluble compounds are less readily absorbed. Organic arsenic compounds have various absorption characteristics. Absorption of inhaled arsenic compounds also depends on the chemical form and on particle size (U.S. PHS, 1989). Absorption through intact skin has not been adequately characterized. Since dermal contact is associated with skin irritation there must at least be local absorption of arsenic, if not systemic absorption (U.S. PHS, 1989).

Distribution - Inorganic arsenic is distributed throughout the body by the blood, and initially accumulates in liver, kidney, lung, spleen, aorta, skin, hair, and upper gastrointestinal tract. Retention depends on the specific arsenic species (U.S. PHS, 1989). The highest levels are found in hair and nails. Lungs and skin have higher concentrations than other soft tissues. A portion of inhaled arsenic may bind irreversibly to lung tissue (U.S. PHS, 1989).

Metabolism - In humans and most animals, trivalent inorganic arsenic is metabolized to dimethylarsinic acid (DMA) and monomethylarsonic acid (MMA). Methylation occurs largely in the liver. The methylation enzyme system may become saturated beginning at a dose between 0.5 and 1 mg/day (U.S. PHS, 1989). Arsenic is excreted largely in the urine of humans, in the proportions of about 60 percent DMA, 20 percent MMA, and 20 percent inorganic compound. The complex forms of arsenic found in fish and shellfish are rapidly excreted in the urine (U.S. PHS, 1989).

Arsenic is thought to be an essential element required in the diet. However, there has never been an identified case of arsenic deficiency in humans (U.S. PHS, 1989).

Carcinogenicity - Arsenic is classified by the U.S. EPA as a Group A, human carcinogen, based on EPA's cancer risk assessment guidelines (U.S. EPA, 1994). This category applies to agents for which sufficient evidence exists and supports causal association between exposure and cancer in humans. The inhalation unit risk is 4.3×10^3 per ug/m³, based on increased lung cancer mortality in smelter workers exposed to arsenic (U.S. EPA, 1994).

The administrator of the EPA has recommended the adoption of a unit risk of 5x10⁻⁵ per ug/L for exposure to arsenic in drinking water (U.S. EPA, 1994). However, risk managers are mandated to note that risk estimates associated with ingested inorganic arsenic could be modified downwards by as much as an order of magnitude, relative to estimates for other carcinogens (U.S. EPA, 1994). The drinking water unit risk was based on increases in the incidence of nonmelanoma skin cancer in a Taiwanese population exposed to high arsenic levels in drinking water. Only a fraction of these skin cancers are fatal. Using standard exposure assumptions (2 L/70 kg/day water ingestion) this unit risk is equivalent to an oral slope factor in water of 1.75 per mg/kg/day dose; this slope factor is used in this assessment for all ingestion exposures.

Threshold Effects - The toxic effect of arsenic ingestion with the lowest threshold is keratosis of the skin, with associated hyperpigmentation, observed in human populations consuming water containing arsenic at concentrations of 0.17 mg/L or higher (U.S. EPA, 1994). Several other

toxic effects have been noted such as anemia, leukopenia, gastrointestinal distress, hepatic and renal injury, and neuropathies (U.S. PHS, 1989). Chronic oral exposures of humans to arsenic has been shown to cause peripheral neuropathy, skin lesions, and a peripheral circulatory disease called blackfoot, characterized by gangrene of the extremities (U.S. EPA, 1984). The EPA has selected $3x10^{-4}$ mg/kg/day as the chronic oral reference dose based on keratosis, hyperpigmentation, and possible vascular complications, all in humans (U.S. EPA, 1994). An uncertainty factor of 3 was used.

Occupational exposure to airborne arsenic is associated with some risk of hyperpigmentation and keratosis, and irritation of the skin and mucous membranes (U.S. PHS, 1989). Inhalation of some arsenic compounds causes an acute toxicity, including skin lesions, cardiovascular and respiratory effects, and peripheral neuropathy (U.S. EPA, 1984). The EPA has not selected a reference dose for inhalation of arsenic.

Reproductive/Developmental Effects - According to the U.S. EPA Gold Book, arsenic is more toxic in early life stages than chronically (U.S. EPA, 1986). Some prominent developmental effects include decreased fetal weights and the occurrence of fetal malformations (U.S. EPA, 1984). Possibly in support of this, a study by Boxley, et al. (U.S. EPA, 1984) indicated that a single oral dose of 40 to 45 mg/kg body weight on any day of gestation between days 8 and 15 will produce adverse effects in developing mice.

References

- U.S. EPA, 1984. Health Effects Assessment for Arsenic. Office of Research and Development. Cincinnati, Ohio.
- U.S. EPA, 1986. Quality Criteria for Water. EPA/440-5-86-001.
- U.S. EPA, 1994. Integrated Risk Information System (IRIS) online database; Arsenic, dated 6/1/94.
- U.S. Public Health Service, 1989. Toxicological Profile for Arsenic.

Barium

Absorption - Results of studies with experimental animals suggest that the rate and extent of absorption of barium from the respiratory tract depends on the exposure level. Initially, barium is deposited in the nasal region and eventually it is absorbed into the body (U.S. PHS, 1990). Barium is poorly absorbed from the gastrointestinal tract upon oral exposure.

Distribution - Barium injected into the mouse is distributed widely, but principally in the bone (U.S. EPA, 1987).

Metabolism - Barium levels in human bone do not change markedly with increasing age (U.S. EPA, 1987).

Carcinogenicity - Barium has not been classified for carcinogenicity on IRIS (U.S. EPA, 1992).

Threshold Effects - The chronic oral RfD for barium was generated based on humans drinking water with 10 mg/L barium in the form of barium chloride, where increased blood pressure was the critical effect (U.S. EPA, 1992). The chronic oral RfD is 7.0x10⁻² mg/kg/day (U.S. EPA, 1992).

Reproductive/Developmental Effects - No human or animal studies could be located regarding reproductive effects following exposure to barium. Developmental effects were reported in one study where female rats were orally administered barium carbonate and the observed effects included increased mortality and disturbances in liver function (U.S. PHS, 1990).

References

U.S. EPA, 1987. Health Advisories for Legionella and Seven Inorganics. March 1987. PB87-235586.

U.S. EPA, 1992. Integrated Risk Information System (IRIS) online database; Barium, dated 1/20/92.

U.S. Public Health Service, 1990. Toxicological Profile for Barium.

Beryllium

Absorption - Based on animal studies, compounds of beryllium appear to be poorly absorbed both through the GI tract and the skin. Absorption most readily occurs via inhalation. Factors such as dose, particle size and solubility play an important role in determining absorption rates and clearance (U.S. PHS, 1987). Acute dermal exposure to soluble beryllium compounds may cause contact dermatitis due to its ability to penetrate the skin.

Distribution - Human tissue analysis from occupationally exposed workers indicates that inhaled beryllium is found at highest concentrations in the lungs and bones, with lower concentrations in the liver and kidneys. Hamster studies indicate that upon oral administration of beryllium, appreciable concentrations could be observed in the liver, large and small intestines, kidneys, lung, stomach and spleen (U.S. PHS, 1987).

Metabolism - Beryllium and its compounds are not biotransformed; however, soluble beryllium compounds are partially converted to more soluble forms in the lungs (U.S. PHS, 1987). As observed in animal studies, beryllium is primarily excreted in the feces, and only trace amounts appear in the urine. This observation has been attributed to beryllium's poor absorption through the GI tract.

Carcinogenicity - Beryllium is classified in Group B2, as a probable human carcinogen, based on lung cancer resulting from inhalation in rats and monkeys and osteosarcomas resulting from intravenous or intramedullary injection in rabbits (U.S. EPA, 1993). The oral slope factor for beryllium is 4.3 per mg/kg/day, based on a slight, statistically insignificant increase in total cancers in rats drinking beryllium sulfate in drinking water at 5 ppm (U.S. EPA, 1993).

Threshold Effects - The chronic oral RfD for beryllium was generated from a NOAEL of 0.54 mg/kg bw/day in a rat drinking water bioassay (U.S. EPA, 1993). Exposure was for the lifetime of the animals. The rats were dissected after natural death and gross and microscopic changes were noted is the heart, kidney, liver and spleen. A chronic oral RfD of 5 x 10⁻³ mg/kg/day was generated by the U.S. EPA (U.S. EPA, 1993); based on no adverse effects observed. An oral uncertainty factor of 100 reflects compensation for inter-species differences and for the protection of sensitive human subpopulations. No inhalation RfD is available.

Reproductive/Developmental Effects - Data regarding reproductive toxicity resulting from beryllium exposure could not be located. Developmental effects have been observed. Injection of beryllium salts into pregnant mice resulted in behavioral abnormalities in the offspring. Intratracheal administration of beryllium oxide and chloride to pregnant rats resulted in increased fetal mortality, decreased fetal weight and increased internal abnormalities (U.S. PHS, 1987).

References

U.S. EPA, 1993. Integrated Risk Information System (IRIS) online database; Beryllium, dated 2/1/93.

U.S. PHS, 1987. Toxicological Profile for Beryllium.

Cadmium

Absorption - The EPA assumes that approximately 2.5% of cadmium in food is absorbed and approximately 5% of cadmium in water is absorbed. Cadmium is also absorbed through the lung after inhalation (30 to 50%), but very little enters the body through the skin (U.S. PHS, 1988).

Distribution - Cadmium is widely distributed throughout the body. The primary organs of concentration are the kidney and liver (U.S. EPA, 1987).

Metabolism - Some of the cadmium in the body complexes with a low molecular weight protein called metallothionein (U.S. EPA, 1987). The half-life of cadmium in humans has been estimated as between 10 and 33 years (U.S. EPA, 1987). In an EPA model it is assumed that 0.01% of the cadmium body burden is eliminated each day (U.S. EPA, 1994). Once cadmium enters the body it is strongly retained, so even small chronic exposures can result in high levels of cadmium in the body (U.S. PHS, 1988).

Carcinogenicity - Cadmium is classified a B1, probable human carcinogen, based on limited evidence from an epidemiologic study on inhalation exposures to cadmium by smelter workers, and sufficient evidence in animal studies (U.S. EPA, 1994). Exposure to cadmium as cadmium chloride in air by rats resulted in significant increases in lung tumors. Intratracheal exposure to rats resulted in mammary tumors in females and tumors in multiple sites in males. Tumors have been reported in rats and mice following injection exposures to cadmium compounds. There is insufficient data to quantify the carcinogenicity of cadmium by the oral route (U.S. EPA, 1994).

Threshold Effects - There are two chronic oral reference doses (RfDs) for use when evaluating oral exposure to cadmium. The RfDs are not based on any one study, but rather on the highest level of cadmium in the human renal cortex not associated with proteinuria, combined with a toxicokinetic model (U.S. EPA, 1994). Since the absorption of cadmium from water and food varies, two RfDs have been developed: 5×10^4 mg/kg/day for exposure to cadmium in water and 1×10^{-3} mg/kg/day for exposure to cadmium in food (U.S. EPA, 1994).

Reproductive/Developmental Effects - Cadmium exposure has not been shown to results in developmental or reproductive effects in humans. Exposure to cadmium by gavage in pregnant rats has resulted in decreased birth weight, impaired neurologic development in the fetus, and fused or absent legs in rat fetuses. Inhalation studies have noted decreased maternal weight gain

and decreased fetal weights in rats (U.S. PHS, 1988). No reproductive effects have been reported following inhalation exposures in animals.

References

- U.S. EPA, 1987. Health Advisories for Legionella and Seven Inorganics. March, 1987. PB87-235586.
- U.S. EPA, 1994. Integrated Risk Information System (IRIS) online database; Cadmium, dated 2/7/94.
- U.S. Public Health Service, 1988. Toxicological Profile for Cadmium.

Chromium

The toxicity of chromium is dependent on the form present. This toxicity profile covers both Chromium III (trivalent chromium, or Cr III) and Chromium VI (hexavalent chromium, or Cr VI). Trivalent chromium is an essential nutrient.

Absorption - Chromium can enter the body by ingestion, inhalation and dermal exposures. Entry by ingestion and inhalation are expected to be the primary routes of exposure for the general population (U.S. PHS, 1989). However, only about one percent of dietary chromium is absorbed (Hammond and Beliles, 1980). A typical daily intake is 60 μ g per day, 10 μ g of which are from water (Hammond and Beliles, 1980).

Distribution - Distribution studies in animals have shown high levels of chromium in the kidney, lungs, and spleen (U.S. PHS, 1989).

Metabolism and Excretion - There is some evidence that some Cr VI is reduced to Cr III, an essential element in the body. Information on excretion was not located.

Carcinogenicity - Chromium VI is classified a Group A human carcinogen by inhalation, based on human data supported by animal data, epidemiologic studies of chromate production in four countries, and three studies of the chrome pigment industry in Norway, England, the Netherlands, and Germany. All these studies have linked exposure to lung cancer. Implant site tumors developed when Cr VI was injected into various tissues in rats (U.S. EPA, 1994a). There are no long-term studies of ingested Cr VI. There is no evidence of carcinogenicity for Cr III; whereas Cr VI has been shown to be both carcinogenic and mutagenic, Chromium III has not (U.S. EPA, 1994b).

Threshold Effects - Chromium VI is an irritant that can result in adverse effects at the point of contact resulting in ulcers of the skin, irritation of the nasal mucosa and gastrointestinal tract. It also can cause adverse effects in the kidney and liver (U.S. PHS, 1989). The chronic oral reference dose (RfD) developed by the EPA for Cr VI is 5 x 10^{-3} mg/kg/day, based on oral ingestion by rats of potassium chromate (K_2CrO_4) (U.S. EPA, 1994a). The chronic oral RfD for Cr III as an insoluble salt is 1 mg/kg/day (U.S. EPA, 1994b), based on oral ingestion of chromic oxide (Cr_2O_3) by rats. No critical effect was observed in the studies from which either of the RfDs were derived (U.S. EPA, 1994a; 1994b).

Reproductive and Developmental Effects - Studies evaluating developmental effects in humans by oral, inhalation or dermal exposures are not adequate to show effects from either Cr III or Cr VI. Increased fetal death and external abnormalities have been documented following injected exposures in hamsters (U.S. PHS, 1989).

References

- Hammond, P.B., and R.P. Beliles, 1980. "Metals" in Casarett and Doull's Toxicology, 2nd ed. Doull, Klaasen, and Amdur, eds. MacMillan, New York.
- U.S. EPA, 1994a. Integrated Risk Information System (IRIS) online database; Chromium (VI), dated 9/1/94.
- U.S. EPA, 1994b. Integrated Risk Information System (IRIS) online database; Chromium (III), Insoluble Salts, dated 9/1/94.

U.S. PHS, 1989. Toxicological Profile for Chromium. Prepared for Agency for Toxic Substances and Disease Registry (ATSDR), Atlanta, GA.

Cobalt

Absorption - Upon inhalation, cobalt is deposited in the upper and lower respiratory tract and is subsequently absorbed by several mechanisms (U.S. PHS, 1990). These particles are usually translocated into the blood upon dissolution or mechanically transferred to the GI tract by mucociliary action of the respiratory tract and swallowing. In humans, iron deficiency leads to a more widespread absorption of cobalt from the GI tract upon oral administration. No human dermal data exist regarding cobalt absorption.

Distribution - Cobalt is found in most human body tissues, since its an essential element, with the highest concentrations found in the liver. Other tissues in which cobalt has been found include muscle, lung, lymph nodes, heart, skin, bone, hair, stomach, brain, pancreatic juice, kidneys, plasma, and urinary bladder (U.S. PHS, 1990).

Metabolism - Cobalt is a metal and an essential element, and as such, it is not metabolized.

Carcinogenicity - No data exist to assess carcinogenic effects.

Threshold Effects - Insufficient data exist to establish oral and inhalation reference doses.

Reproductive/Developmental Effects - No studies regarding reproductive effects in humans exposed to cobalt have been located; however, in rats, testicular degeneration and atrophy have been reported, following ingestion of water or food containing cobalt. No developmental effects have been observed on human fetuses of pregnant women treated with cobalt chloride in order to raise their hematocrit and hemoglobin levels (U.S. PHS, 1990).

References

U.S. Public Health Service, 1990. Toxicological Profile for Cobalt.

Copper

Absorption - Absorption of ingested copper ranges from 15 to 97% (U.S. EPA, 1984). Quantitative data for inhalation absorption are not available.

Distribution - Absorbed copper is rapidly transported to blood serum and taken up by the liver and further transported in the blood plasma. The highest tissue concentrations are found in the liver and brains (U.S. EPA, 1984).

Metabolism - Copper is incorporated into copper proteins in mammals (U.S. EPA, 1984). Copper is an essential nutrient in trace quantities.

Carcinogenicity - Copper is classified in Group D due to a lack of human data, deficient animal data, and ambiguous mutagenicity data (U.S. EPA, 1992).

Threshold Effects - Ingestion of copper results in a number of elimination responses such as nausea, vomiting, gastritis, and diarrhea. Systematic toxic effects can include hemolysis, liver problems, gastrointestinal bleeding, anemia, convulsions, and death (Clement, 1985). Exposure to copper dust can cause short-term illness characterized by chills, fever, aching muscles, and headache. No chronic oral RfD has been calculated for copper (U.S. EPA, 1992). The drinking water action level of 1.3 mg/L is presented in HEAST (U.S. EPA, 1994).

Reproductive/Developmental Effects - No studies documenting reproductive and/or developmental toxicity were found.

References

- Clement Associates, Inc., 1985. Chemical, Physical and Biological Properties of Compounds Present at Hazardous Waste Sites. Prepared for U.S. EPA.
- U.S. EPA, 1984. Health Effects Assessment for Copper. Office of Research and Development. Cincinnati, Ohio.
- U.S. EPA, 1992. Integrated Risk Information System (IRIS) online database; Copper, dated 1/22/92.
- U.S. EPA, 1994. Health Effects Assessment Summary Tables, Annual FY-1994. Office of Research and Development - Office of Emergency and Remedial Response, U.S. EPA, Washington, D.C. OERR 9200.6-303(94-1).

Lead

Absorption - Oral absorption of lead has been estimated at 15% for adults and 50% for children, with adult absorption of lead ranging as high as 45% under fasting conditions (U.S. PHS, 1990). Inhalation absorption of the inhalable fraction of lead particles approaches 100% over time. Dermal absorption ranged from 0 to 0.3% in one study (U.S. PHS, 1990).

Distribution - Distribution of lead in the body is described with a three compartment model, including blood, soft tissue, and bone (U.S. PHS, 1990). Following chronic exposures, most of the body burden of lead is in bone (U.S. PHS, 1990).

Metabolism - Inorganic lead does not undergo metabolism in the body (U.S. PHS, 1990).

Carcinogenicity - Based on sufficient statistically significant increases in renal tumors in rats, lead is classified in Group B2 - as a probable human carcinogen (U.S. EPA, 1993). However, the Carcinogen Assessment Group has recommended that a numerical estimate of carcinogenicity not be used, due to the many uncertainties associated with lead (U.S. EPA, 1993).

Threshold Effects - Lead decreases circulating vitamin D and at high levels can produce encephalopathy, colic, anemia, and neuropathy. Because lead accumulates in bone, from which it can be mobilized and redistributed in the body, past cumulative exposure contributes to the risk (U.S. PHS, 1990). Some adverse health effects, such as changes in blood enzymes and the neurobehavioral development of children, occur at extremely low blood lead levels (U.S. EPA, 1993). Because these effects occur essentially without a threshold, the EPA RfD work group concluded that it was inappropriate to develop an RfD for inorganic lead (U.S. EPA, 1993).

Reproductive/Developmental Effects - Lead produces a variety of reproductive effects in both male and female rats (U.S. PHS, 1990). Female rats exhibited irregular estrous cycles, ovarian cysts, and reduced egg production, while male rats experienced testicular atrophy, decreased sperm count, and reduced sperm mobility (U.S. PHS, 1990). Decreased birth weights and an increase in the number of stillbirths also resulted (U.S. PHS, 1990).

References

U.S. EPA, 1993. Integrated Risk Information System (IRIS) online database; Lead, dated 11/1/93.

U.S. Public Health Service, 1990. Toxicological Profile for Lead.

Manganese

Absorption - Inhaled manganese is absorbed directly into the bloodstream only if the particles are small enough to reach the alveoli. Larger particles would be cleared by mucociliary action and swallowed. From a human study of inhaled manganese aerosol absorption in which roughly half of the manganese deposited in the lungs was recovered in waste within four days, EPA reported a conclusion that relatively little pulmonary absorption occurred (U.S. EPA, 1984). The rationale for this conclusion was not elaborated. Large oral doses of manganese salts cause

gastrointestinal irritation, which reduces absorption of high doses (Hammond and Beliles, 1980). The principal portion of intake is from food (Hammond and Beliles, 1980).

Distribution - Enterohepatic circulation of manganese has been reported (U.S. EPA, 1984). This circulation consists of release of manganese in the bile and reabsorption in the duodenum. A fairly constant body burden of 20 mg appears to be maintained by a homeostatic system (Hammond and Beliles, 1980). The highest concentrations are found in the liver, kidney, intestine, and pancreas (Hammond and Beliles, 1980). Manganese does not accumulate in the lungs over time, even with chronic exposure (Hammond and Beliles, 1980).

Metabolism and Excretion - Manganese is an essential element in the diet (U.S. EPA, 1994). Since manganese in any valence state promotes rapid elimination of radiolabeled manganese (Hammond and Beliles, 1980), it is likely that the various valence states are interconvertible in the body. Excretion is predominantly through bile (Hammond and Beliles, 1980).

Carcinogenicity - Manganese salts have produced tumors in mice when injected. However, there is insufficient evidence to consider manganese as a carcinogen; it is classified in Group D (U.S. EPA, 1994).

Threshold Effects - Manganese is an essential nutrient. The National Resource Council determined that 2-5 mg of manganese is "safe and adequate" for adults, which is equivalent to 0.03 to 0.07 mg/kg/day. Oral reference doses (RfDs) are available for manganese in food and manganese in water. The chronic oral RfD for manganese in food is 0.14 mg/kg/day (U.S. EPA, 1994), based on the lack of central nervous system effects in humans who consumed a normal diet (U.S. EPA, 1994). The chronic oral RfD for manganese in water is 0.005 mg/kg/day (U.S. EPA, 1994), based on the lack of central nervous system effects in humans consuming water with an average manganese content of 167 μ g/L. An uncertainty factor of 1 was used to derive the food and water RfDs (U.S. EPA, 1994). No RfDs are specifically designated for exposure to manganese in soil.

Reproductive and Developmental Effects - One EPA source reported that exposure to manganese has been connected to impotency, increased stillbirths, and an increase in the number of spontaneous abortions in humans (U.S. EPA, 1984). Another reported that no epidemiological studies had suggested teratogenic or reproductive effects in humans (Clement, 1985). Mice exposed to manganese exhibited retarded sexual development while rats showed a decrease in testosterone without interference to reproductive success (U.S. EPA, 1984).

References

- Clement Associates, Inc., 1985. Chemical, Physical and Biological Properties of Compounds Present at Hazardous Waste Sites. Prepared for U.S. EPA.
- Hammond, P.B. and R.P. Beliles, 1980. "Metals" in Casasett and Doull's Toxicology, Doull, Klaasen, and Amdur, eds. New York, MacMillan.
- U.S. EPA, 1984. Health Effects Assessment for Manganese (and Compounds). Office of Research and Development, Cincinnati, Ohio.
- U.S. EPA, 1994. Integrated Risk Information System (IRIS) online database; Manganese, dated 4/6/94.

Mercury

Absorption - Data on the absorption of inorganic mercury are limited. However, results from animal and human studies indicate that inorganic mercury is readily absorbed through the respiratory tract and minimally absorbed from the gastrointestinal tract (U.S. PHS, 1988). A comparative rate of absorption of inorganic mercury through the skin is unavailable, although animal studies report uptake after dermal exposure (U.S. PHS, 1988).

Distribution - Data from animal studies involving inhalation exposures indicate that inorganic mercury, which is highly diffusible and lipophilic once absorbed, can be found in all body tissues. Accumulation of inorganic mercury is reported to occur in the kidneys, intestinal mucosa, epithelial layers of the skin, salivary and sweat glands, pancreas, testes, prostate, brain, and, to some extent, the lung and pleural cavities (U.S. PHS, 1988).

Metabolism - Inorganic mercury is rapidly oxidized in red blood cells and the lungs to its divalent form and subsequently reduced to elemental mercury (U.S. PHS, 1988). Results from studies with rats suggest that inorganic mercury is also oxidized by the liver. Mercury is ultimately eliminated in the urine and feces; however, exhalation and excretion in saliva and sweat may also occur (U.S. PHS, 1988).

Carcinogenicity - Due to lack of human data and inadequate animal data, mercury has been classified in Group D (U.S. EPA, 1994a).

Threshold Effects - The chronic oral RfD was determined to be 3 x 10⁴ mg/kg/day (U.S. EPA, 1994b). This value was determined from several oral, parenteral studies in the Brown Norway rat. The critical effect observed was kidney toxicity. An oral RfD uncertainty factor of 1000 was used (U.S. EPA, 1994b).

Reproductive/Developmental Effects - No reliable data are available on the reproductive or developmental effects of inorganic mercury.

References

- U.S. EPA, 1994a. Integrated Risk Information System (IRIS) online database; Mercury, dated 4/6/94.
- U.S. EPA, 1994b. Health Effects Assessment Summary Tables, Annual FY-1994. Office of Research and Development. Office of Emergency and Remedial Response, U.S. EPA, Washington, D.C. OERR 9200.6-303(94-1).
- U.S. Public Health Service, 1988. Toxicological Profile for Mercury.

Nickel

Absorption - Nickel is absorbed primarily through the skin and gastrointestinal tract. Animal studies have shown that the rate of absorption of nickel, following inhalation exposure, is

inversely related to particle size; where smaller particles have a greater capability of infiltrating lung tissue (U.S. PHS, 1987).

Distribution - Data from animal studies indicate that the location of nickel accumulation in the body may depend on the exposure route. Both inhalation and oral exposures result in accumulation of nickel by the lung and kidneys; however, elevated concentrations of nickel in the heart, central nervous system, and testes have also been reported following oral exposure (U.S. PHS, 1987). Accumulation of nickel in the hair also occurs (U.S. PHS, 1987) and may be exacerbated by dermal exposure. Nickel is a normal component of blood serum in humans at concentrations of approximately 1.6 μ g/L (U.S. PHS, 1987).

Metabolism - Absorbed nickel is transported in the vascular system bound to serum albumin, L-histidine, and 2-macroglobulin. Nickel is transferred across membranes to target organs as L-histidine, and may be excreted in the urine, after passing through the kidneys, or be released in sweat (U.S. PHS, 1987). Nickel that is not absorbed from the gastrointestinal tract is excreted in the feces (U.S. PHS, 1987).

Carcinogenicity - Based on sufficient evidence of cancer in humans from inhalation exposure, nickel is classified in Group A, as a human carcinogen by inhalation (U.S. EPA, 1994b). Increased risks of lung and nasal cancer in humans exposed to nickel refinery dust (most of which was believed to have been nickel subsulfide), increased tumor incidences in animals by several routes of administration in several animal species and strains, and positive results in genotoxicity assays form the basis for the classification. Exposure to nickel compounds by the oral route has not been classified for carcinogenicity.

Threshold Effects - A chronic oral RfD of 2 x 10⁻² mg/kg/day was determined for nickel, based on a chronic oral rat study; nickel from nickel sulfate was administered in the diets of rats in a 2 year study (U.S. EPA, 1994a). Decreased body and organ weights are listed as the critical effects.

Reproductive/Developmental Effects - Reported reproductive effects are based on rat studies and include testicular degeneration, resulting in a decrease in male fertility, and pregnancy complications in females (U.S. PHS, 1987). Developmental effects are supported by data from animal studies and include low birth weight, embryonic malformations, and stillbirths.

References

- U.S. EPA, 1994a. Integrated Risk Information System (IRIS) online database; Nickel, dated 8/1/94.
- U.S. EPA, 1994b. Health Effects Assessment Summary Tables, Annual FY-1994. Office of Research and Development. Office of Emergency and Remedial Response, U.S. EPA, Washington, D.C. OERR 9200.6-303(94-1).
- U.S. Public Health Service, 1987. Toxicological Profile for Nickel.

Vanadium

Absorption - Once inhaled, vanadium absorption occurs in humans as observed primarily in the occupational setting. Intratracheal administration of vanadium in rats support the evidence that vanadium absorption in humans may occur following acute exposure (U.S. PHS, 1990). The absorption of vanadium through the gastrointestinal tract or the skin is very low.

Distribution - Data regarding distribution of vanadium in humans immediately following exposure is inconclusive. At autopsy, vanadium has been detected primarily in the lungs and intestines of humans (U.S. PHS, 1990). Rapid distribution occurs in rats, upon acute intratracheal administration. Retention of vanadium primarily occurs in the bones (U.S. PHS, 1990).

Metabolism - Because vanadium is an element, it is not metabolized. However, in the body, vanadium interconversion occurs to two oxidation states: vanadyl (the tetravalent form) and

vanadate (the pentavalent form); vanadate being more toxic than vanadyl. Vanadium in the plasma may exist in a bound or unbound form (U.S. PHS, 1990).

Carcinogenicity - EPA has not classified vanadium for carcinogenicity.

Threshold Effects - Based on a chronic oral lifetime drinking water study done in rats, a chronic oral RfD of 7 x 10⁻³ mg/kg/day was derived (U.S. EPA, 1994). The RfD is based on no observed effects in rats administered vanadium from vanadyl sulfate in drinking water for a lifetime (U.S. EPA, 1994). An uncertainty factor of 100 was used.

Reproductive/Developmental Effects - No studies have been located regarding reproductive effects in humans or animals (U.S. PHS, 1990). Studies have not identified developmental effects from vanadium exposure (U.S. PHS, 1990). One study showed no embryolethality, teratogenicity or significant skeleton or viceral abnormalities in pups exposed during gestation (U.S. PHS, 1990). There was an increase in facial and dorsal hemorrhage but its toxicological significance is unknown.

References

- U.S. EPA, 1994. Health Effects Assessment Summary Tables, Annual FY-1994. Office of Research and Development. Office of Emergency and Remedial Response, U.S. EPA, Washington, D.C. OERR 9200.6-303(94-1).
- U.S. Public Health Service, 1990. Toxicological Profile for Vanadium.

Zinc

Absorption - Approximately 20 percent to 30 percent of zinc ingested is absorbed in the gastrointestinal tract. Inhalation absorption is assumed since toxicity results from inhalation exposures to zinc oxide fume, but this absorption is not quantified (U.S. PHS, 1989).

Distribution - The majority of zinc is in the prostate, muscle and bone. It is also found in a number of other organs, such as the kidneys, liver, and heart (U.S. PHS, 1989).

Metabolism - Studies indicate that zinc levels in humans are homeostatically controlled, meaning that absorption and excretion of zinc vary depending on bodily needs (U.S. PHS, 1989).

Carcinogenicity - There is no evidence that zinc is a carcinogen and is, therefore, classified in Group D (U.S. EPA, 1992).

Threshold Effects - Zinc is a necessary metal for the human body. The chronic oral RfD is 0.3 mg/kg/day, based on decreased blood enzyme from therapeutic dosages to humans (U.S. EPA, 1992). The U.S. EPA has concluded that adverse health effects are not expected from zinc in drinking water, so it is not presently regulated.

Reproductive/Developmental Effects - Zinc-induced anemia can prevent reproduction. Elevated levels in the diet can reduce fetal body weights, decrease fetal concentrations of iron and copper, increase fetal resorption, and reduce growth in offspring (U.S. PHS, 1989).

References

- U.S. EPA, 1992. Integrated Risk Information System (IRIS) online database; Zinc, dated 10/7/92.
- U.S. Public Health Service, 1989. Toxicological Profile for Zinc.

APPENDIX H
1986 Analytical and Field Data
From Site 4

ENVIRONMENTAL SERVICE GROUP

E.S.G., INC.

520 VIRGINIA AVE. INDIANAPOLIS, IN 46203

317-635-1123





Lt. Ben Vohrees Indiana National Guard Hulman Regional Airport Terre Haute, IN 47803-5320

Re: Laboratory Numbers 861098-1 Through 861098-45

Report for 37 Soil and 8 Water Samples Taken from Old Fuel Storage Area

Dear Lt. Vohrees:

One correction should be made in the results shown for samples no. 40 WS-9-10" and no. 43 WS-10-6". The Oil and Grease results were transposed for these two samples. The corrected readings should be:

		Oil & Grease	TOC	TOX
#40	WS-9-10"	0.004%	46 ppm	30 ppb
#43	WS-10-6"	1.1%	1510 ppm	190 ppb

The EPA has \underline{no} guidelines covering soils for Oil and Grease, Total Organic Carbon, or Total Organic Halogens. In consultation with Mr. George Oliver, Chief of Special Projects, Department of Environmental Management for Indiana, and Mr. Thomas M. Schubert, P.E., of Triad Associates, Inc., we found that these guidelines may be followed for reuse of the tested area.

If no soil is to be removed from the area and proper containment levees are in place, there should be no problem for new fuel storage tanks.

Water runoff should be prevented, or, if it does occur, it should be monitored.

If you have any questions or need further information, please feel free to contact our office.

Very truly yours,

E.S.G., INC.

Robert L. Kent, PhD

President

RLK/bm

SAMPLE OLD BLADDER AREA - HULMAN FLD., IND. DESCRIPTION Augered Hole
6/9-1545-6/10 0915 overnight No. Woter or Soil Souple 1. WS-5 weter Sample 57#4 SOIL SAMPLE 1.2' below 2. 65-4-1.5 ST#4 SOIL SAMPLE 3.0' below 3. 65-4-3.0 Soil SAMPLE 1.5' below 57#3 4. 65-3-1.5 Soil SAMPLE 3.0 below 57#3
(Hit Water/Rock) FIELD TILE FOUND 5. 65-3-3.0 Soil SAMPLE 1.5' below ST#7 6. 45-7-1.5 rocks & pebblass SOIL SAMPLE 3.0' balow ST#7 7 GS -7-3.0 break down of (biodegradeble)
only soil
postile 5T# 5 SOIL SAMPLE 1.5' below 8.8. 65-5-1.5 SOIL Y CLAY CBUE CLAY) biodogradeble oily soil
possibly ST #5 \$ 65-5-3.0

H-2

SOIL SAMPLE 3.0' below SOIL FCLAY (BWE CLAY) biodegradeble oily soil possibly

OLD BLADDER AREA - HOLMAN FLD, IND. 10. 45-6-1.5 SOIL SAMPLE 1.5' below 57#6 biodogradable oily soil
possibly 6--6-3.0 12 65-9-1.5 SOIL SAMPLE 1.5' below HORNAL LOOKING SOIL 13. GS-9-3.0 SOIL F WATER SOIL SAMPLE 1.5 below ST#8 14. 65-8-1.5 12. GS-8-3.0 Soil SAMPLE 3.0' below ST#8
Fuel in Clay Soil Soil Sample 4.0 below ST#8

suight Fuel in Clay GS-8-4-0 17. GS-8-4.5 SOIL SAMPLE 4.5' below ST #8 Soil SAMPLE 1.5' below ST # 2 Some GRANER H-3

18. 65-2-1.5

THATE & OLD BLADDER AREA - HULMAN FLD, IND.

19 GS-Z-3.0 SOUL SAMPLE 3'N' ROOMS ST#2

20. G5-1-1.5 SOIL SAMPLE 1.5' Below 57#1

21. GS-1-3.0 SOIL SAMPLE 3.0' Below ST#1

FUEL IN SOIL (STrong)

22. GS-1-4.0 Soil SAMPLE 4.0: Balons ST#1

501L SAMPLE 4.0' Below ST#1

FUEL IN SOIL

(STRONG + HOWY)

GS-10-4.5 SOIL SAMPLE 4.5' Below ST#1
FUEL IN SOIL

25. GS-11-1.5 Soil SAMPLE 1.5' Below 87#11

U. GS-8-5.5 CORE SAMPLE 5.5' Below ST#8
(Soil SAMPLE)

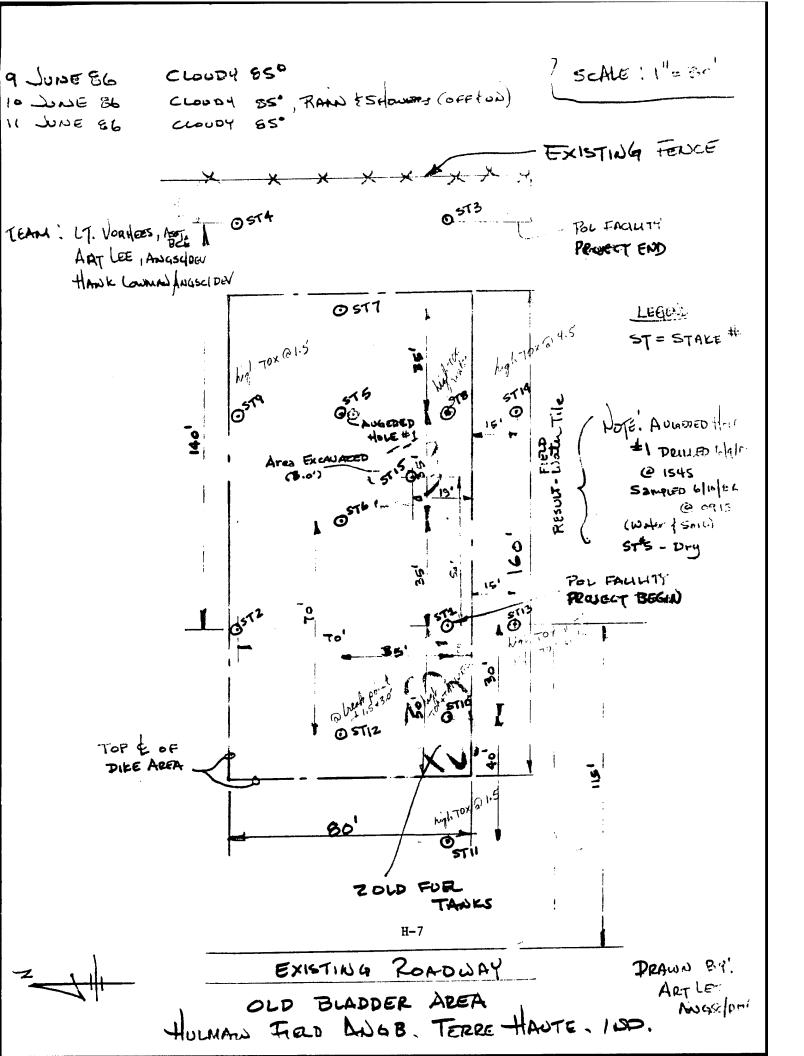
17. GS-11-3.0 Soil SAMPLE 3.0'Below ST #1

SAMPLE: 86

OLD BLADDER AREA - HOLMAN FLD, IND.

28.	6>-14-1.5	SOIL SAMPLE	1.2' below	5T#14
29.	GS-14-3.0	SOIL SAMPLE	3.0' belos	ST#14
50.	65-13-1.5	SOIL SAMPLE	1.5' below	ST#13
31.	Gs-13-3.0	SOIL SAMPLE	3.0' below	ST#13
32.	65-13-45	Soil Sample	4.5 ' bela	57413
33 .	65-14-4.5	Soil Sample	4.5' bela	57414
	GS-15-4.5'	SOIL SAMPLE	4.5 bila	r ST#18

34	65-15-4.5	SOIL SAMPLE 4.5 Pelow	
三五	G	SOIL SAMPLE 7.3 BELON ST	
36	GS - 13 12 1.5	SOIL SAMPLE 1.5 AT 1	
.37	GS - 12 3.0	SOIL SAMPLE 3.0 AT +	/
38	W-S - 4 - 7"	WATER SAMPLE 7" AT	
39	W.5 - 3 -11"	WATER SAMPLE II" AT #	٠
40	W5-9-10"	WATER SAMPLE 10" AT	•
41	WS-8-17"	WATER SAMPLE 17" AT	
42	W5-2-9"	WATER SAMPLE 9" AT	
43	NS-10 - 6"	WATER SAMPLE & AT #	
44	WS-11-8/2"	WATER SAMPLE 8/2 AT	
45	WS-13-16"	WATER SAMPLE 16" AT HE	F 1



ENVIRONMENTAL SERVICE GROUP

E.S.G., INC.

520 VIRGINIA AVE. INDIANAPOLIS, IN 46203

317-635-1123

June 27, 1986



Lt. Ben Vohrees Indiana National Guard Hulman Regional Airport Terre Haute, IN 47803-5320

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	•	Oil & Grease	TOC	<u>TOX</u>
11.0	WS-9-10"	0.004%	46 ppm	30 ppb
#40	W3-7-10	4 10/	1510 ppm	190 ppb
#43	WS-10-6"	1.1%	12.10 PP	

The EPA has <u>no</u> guidelines covering soils for Oil and Grease, Total Organic Carbon, or Total Organic Halogens. In consultation with Mr. George Oliver, Chief of Special Projects, Department of Environmental Management for Indiana, and Mr. Thomas M. Schubert, P.E., of Triad Associates, Inc., we found that these guidelines may be followed for reuse of the tested area.

If no soil is to be removed from the area and proper containment levees are in place, there should be no problem for new fuel storage tanks.

Water runoff should be prevented, or, if it does occur, it should be monitored.

If you have any questions or need further information, please feel free to contact our office.

Very truly yours,

E.S.G., INC.

Robert L. Kent, PhD

President

RLK/bm

SOIL & WATER SAMPLE ANALYSIS

OLD BLADDER AREA

AT

HULMAN FIELD ANGB, INT.

100

DATE SAMPLED! 10-11 JUNE 86

SAMPUNDE TEAM! LT. BEN VORHEES, ASSIST.

ART LEE, ANYSCIDEN

HANK LOWMAN, ANYSCIDEN

EQUIP. USED! MECH. ADGER, MERSURING WHEEL, STEAM CLEANING, MACHINE, TECHNICAL GRADE-METHYL ALCOHOL, GUASS BALLER, PVC PIPING

Wayton Cowo. Cloud 85°, OFF to N Stlowers

50ME: 1"- 30 4 JUNE 86 CLEODY 55°, RAND & SHOWING (OFF (ON) 10 - WAVE 66 EXISTING FENCE POL FACILITY TEAM : LT. VORILES, 1907 PROJECT END AAT LEE , ANGSGOOW HANK LOWERD ANGSCIDE O517 LEGIN क्ष्या अपूर्वा HOTE. AUGOED H ±! Truncir le S 12.4% 52mp150 6/10/ @ 091 POL FAULTY PROJUCT BEGIN DIKE AREA ZOW FUR DRAWA By EXISTING ROADWAY Anzy List & OLD BLADDER AREA ANCESCI HULMAN FIRD ANGB, TERRE HANTE, 100.

ENVIRONMENTAL SERVICE GROUP

E.S.G., INC.

520 VIRGINIA AVE. INDIANAPOLIS, IN 46203

317-635-1123

June 27, 1986



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Robert L. Kent, PhD

President

RLK/bm

E.S.G., INC.

ENVIRONMENTAL SERVICE GROUP

520 VIRGINIA AVE. INDIANAPOLIS, IN 46203

317-635-1123

June 23, 1986



Base Contracting Office Indiana Air Mational Guard Hulman Regional Airport Terre Haute, III 47803-5320

INVOICE

LAB NUMBER

DESCRIPTION

PRICE

61098-1 Through 45 TESTS PERFORMED ON WATER AND SOIL SAMPLES

\$6,575.00

CONTRACT/PURCH. ORDER NO. DAHA12-86-M-6441

TOTAL AMOUNT DUE THIS INVOICE \$6,575.00

THANK YOU!

ENVIRONMENTAL SERVICE GROUP

E.S.G., INC.

520 VIRGINIA AVE. INDIANAPOLIS, IN 46203

317-635-1123



June 23, 1986

Indiana Air National Guard HQ 181st Tactical Fighter Group Hulman Regional Airport Terre Haute, IN 47803-5000

LABORATORY TESTING NUMBERS 861098-1 through 45

	Oil & Grease	TOC	<u>"POX</u>
#1 WS-5-8.5" #2 GS-4-1.5 #3 GS-4-3 #4 GS-3-1.5 #5 GS-7-1.5 #5 GS-7-3.0 #8 GS-5-1.5 #9 GS-5-3.0 #10 GS-6-1.5 #11 GS-6-3.0 #12 GS-9-1.5 #13 GS-9-3.0 #14 GS-8-1.5 #15 GS-8-3.9 #16 GS-8-4.5 #17 GS-8-4.5 #18 GS-2-1.5 #19 GS-2-3.0 #20 GS-1-1.5 #21 GS-1-3.0 #22 GS-1-4.0 #24 GS-10-4.5 #25 GS-11-1.5 #26 GS-8-5.5 #27 GS-11-1.5 #26 GS-8-5.5 #27 GS-11-1.5 #28 GS-14-1.5 #29 GS-14-3.0 #30 GS-13-1.5 #31 GS-13-3.0 #32 GS-13-4.5 #33 GS-13-4.5 #33 GS-15-4.5 #34 GS-15-4.5 #35 GS-15-6.0	0.007% 0.17 % 0.19 % 0.31 % 0.06 % 0.79 % 0.14 % 0.47 % 0.16 % 0.91 % 0.46 % 0.93 % 0.32 % 0.32 % 0.03 % 0.51 % 0.07 % 0.04 % 0.005% 0.01 % 0.01 % 0.02 % 0.007% 0.03 % 0.15 % 0.09 % 0.09 % 0.09 % 0.09 % 0.09 % 0.09 % 0.09 % 0.09 % 0.09 % 0.09 % 0.09 % 0.09 % 0.09 % 0.09 % 0.005% 0.01 % 0.01 % 0.01 % 0.01 % 0.01 % 0.02 % 0.005% 0.02 % 0.005% 0.02 % 0.005% 0.02 % 0.005% 0.02 % 0.005% 0.02 % 0.005% 0.006%	31 ppn 1.4 % 2.4 2.4 % 2.1 2.4 % 2.1 2.0 % % 3.4 2.0 % % 3.5 1.1 2 0.7 % % % % % % % % % % % % % % % % % % %	\$5ppb 54ug/g 89ug/g 48ug/g 103ug/g 106ug/g 65ug/g 82ug/g 74ug/g 110ug/g 62ug/g 79ug/g 79ug/g 34ug/g 34ug/g 34ug/g 55ug/g 70ug/g 70ug/g 70ug/g 70ug/g 70ug/g 710ug/g 71ug/g 71u

Hulman Testing Results Continued

	oil & Grease	TOC	<u>TON</u>
#36 GS-12-1.5 #37 GS-12-3.0 #38 WS-4-7" #39 US-3-11" #40 US-9-10" #41 WS-8-17" #42 US-2-9" #43 WS-10-6" #44 WS-11-82" #45 WS-13-16"	0.005% 0.004%	2.1 % 1.6 % 24 ppm 31 ppm 46 ppm 40 ppm 104 ppm 105 ppm 105 ppm 105 ppm	120ug/g - Ireah pout 120ug/g - Ireah pout 12ppb 22ppb 30ppb 47ppb 28ppb 190ppb - additional 70ppb inquiry

ug/g - Micrograms/Gram ppm - Parts Per Million ppb - Parts Per Billion

in soil grease considered to high

Respectfully submitted,

Dr. Robert Kent

LABORATORY ANALYSIS REPORT AND	RECORD (General)	200ct 36
	FROM: USAFOEHL/SA	
8	BROOKS AFB	TX 78235-5501
SAMPLE IDENTITY	-	DAYE RECEIVED
		LAB CONTROL NA
WATER SAMPLE FROM		CAB CONTROL NA
TEST FOR		
VOLATILE HALOCARBONS		
METHODOLOGY: EPA 601	••	
METHODOLOGI. 2111 000		l DET
OEHL No.	70357	LIMIT
<u> </u>		
BASE No.	6P360052	
	7/3	0.1
Bromodichloromethane (32101)	24.9	0.2
Bromoform 32104	NP	1.0
Bromomethane 34413	1 10	0.1
Carbon Tetrachloride 32102		0.2
Chlorobenzene 34301		0.5
Chloroethylvinyl ether 34576		0.1
2-CHIOIOECHYIVIII	38.3	0.1
CHIOTOTAL	ND	0.1
CITTOTOMECTIONS	21.4	0.1
DIDI OMOCITICI DALO CITALO	I NO I	1 0.2
1,2-Dichlorobenzene 34536 1,3-Dichlorobenzene 34566		0.2
1,4-Dichlorobenzene 34571		0.2
Dichlorofluoromethane 34668		1 0.1
1,1-Dichloroethane 34496		1 0.2
1,2-Dichloroethane 34531		1 0.2
1,1-Dichloroethene 34501		0.1
transl, 2-Dichloroethene 34546		0.1
1,2-Dichloropropane 34541		0.1
cisl,3-Dichloropropene 34704		1 0.2
transl, 3-Dichloropropene 34699		0.2
Methylene Chloride 34423		0.1
1,1,2,2-Tetrachloroethane34516	!	0.1
Tetrachloroethylene 34475		0.1
1,1,1-Trichloroethane 34506		0.1
1,1,2-Trichloroethane 34511		0.1
Trichloroethylene 39180		0.1
Trichlorofluoromethane 34488 Vinyl Chloride 39175		0.2

Results in micrograms per liter.

ND = None Detected. Less than the detection Limit. TRACE = Present, but quantity less than quantitative limit.

REQUESTING AGENCY (Mailing Address)

181 TAC CLINIC/SGRB HULMAN REGIONAL AIRPORT, TERRE HAUTE, IN

DATE ANALYZED: 17+20 Oct 86

Belander

H-15

Human Field SPLE FROM STFOR AXIMUM TRIHALOMETHANES POTENTI ETHODOLOGY: FPA 501.1 DEHL No. BASE No. Chloroform 32106 Bromodichloromethane 32101 Dibromochloromethane 32105 Bromoform 32104 Total THM 82080	FROM: TO 358 CPEL CO 53 15 11 E.E. .4 < (00		AFB T	DATER	235-5501 RECEIVED OCHOL NATROL NA
THE FROM ST FOR AXIMUM TRIHALOMETHANES POTENTI ETHODOLOGY: FPA 501.1 DEHL No. BASE No. Chloroform 32106 Bromodichloromethane 32101 Dibromochloromethane 32105 Bromoform 32104 Total THM 82080	70358 GPE60053 15 11 e.e.	1001465M		LAB CO	OTSP
TFOR AXIMUM TRIHALOMETHANES POTENTI ETHODOLOGY: FPA 501.1 DEHL No. BASE No. Chloroform 32106 Bromodichloromethane 32101 Dibromochloromethane 32105 Bromoform 32104 Total THM 82080	70358 GPE60053 15 11 e.e.		T /	LAB CO	
ET FOR AXIMUM TRIHALOMETHANES POTENTI ETHODOLOGY: FPA 501.1 DEHL No. BASE No. Chloroform 32106 Bromodichloromethane 32101 Dibromochloromethane 32105 Bromoform 32104 Total THM 82080	70358 GPE60053 15 11 e.e.		T /		NTROL NR
AXIMUM TRIHALOMETHANES POTENTI ETHODOLOGY: FPA 501.1 DEHL No. BASE No. Chloroform 32106 Bromodichloromethane 32101 Dibromochloromethane 32105 Bromoform 32104 Total THM 82080	70358 GPE60053 15 11 e.e.		T /		
ETHODOLOGY: FPA 501.1 DEHL No. BASE No. Chloroform 32106 Bromodichloromethane 32101 Dibromochloromethane 32105 Bromoform 32104 Total THM 82080	70358 GPE60053 15 11 e.e.				
DEHL No. BASE No. Chloroform 32106 Bromodichloromethane 32101 Dibromochloromethane 32105 Bromoform 32104 Total THM 82080	GPELE (05)? 15 11 e.e. 1.4				
Chloroform 32106 Bromodichloromethane 32101 Dibromochloromethane 32105 Bromoform 32104 Total THM 82080	GPELE (05)? 15 11 e.e. 1.4				
Chloroform 32106 Bromodichloromethane 32101 Dibromochloromethane 32105 Bromoform 32104 Total THM 82080	15 11 e.e.				
Bromodichloromethane 32101 Dibromochloromethane 32105 Bromoform 32104 Total THM 82080	11 e.e 1.4				
Bromodichloromethane 32101 Dibromochloromethane 32105 Bromoform 32104 Total THM 82080	11 e.e 1.4				
Dibromochloromethane 32105 Bromoform 32104 Total THM 82080	1.4				
Bromoform 32104 Total THM 82080	1.4				
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Results in micrograms per lit	er.	<u>-l</u>			
resurcs in microdiams ber in					
= None Detected. Less than t	he detect	ion limi	t. ND	< 0.1	L
ACE = Present, but quantity le	ess than o	uantitat	ive li	mit.	TR < 0.2
non - ironomo, but quantitoj re					
te analyzed: 20 Od 86					
QUESTING AGENCY (Mailing Address)					
181 TAC Clinic SGPB					
181 IAC Clinic 351		•	_		_
tulman Reg. Airport		2	os An	rris	on_
_		130			
Terra Haute IN					
47803					

		_																	
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								Hulman Fi					41	د)/					
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(circle if changed)	COPY 2		$^{+}$,		
SAMPLE COLLE		Grade, AFSC)						SIGNATURE	/			II)	 		TAL	JTO	VON		
C W000	lworth	:, Grade, AFSC) 7, 9077	0					Charles 2/	2/0	orl	wtl	th			72	24-	130	28	
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BASE SA	MPLE NUMBER	6 / 8	S) C	P		<u> </u>							\perp			<u></u>			
		A	VAL					k appropriate blocks)	Τ										
VOLATILE HAL	OCARBONS (VO		_		rotluoro		ane	34488	MI	_		NEO							
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	earbon Screen	1001460PH 32101	_						\vdash	Xv	lene							81	710
Bromodichlor	romethane		-	<u> </u>					\top	 		ethyi	ket	one				81	595
Bromotorm		32104 34413	TI	RIHALO	METHA	NFS	(THN	(10860)	+					ceton				81	596
Bromometha		32102	 		TT			S GROUP TI	T	-		reanic					100	210	6011
	chloride	34301	X	Cribale	omethan	r Pot													
Chloroethane		34311			rihalom			82080											
2.Chloroethy		34576																	
Chlorotorm		32106		VOLATI	LE ARC	MAT	ics	(VOA) (10850)											
Chlorometha	ne	34418					PRI	ES GROUP T1											
Dibromochlo	romethane	32105		Volati	le Arom:	atic S	creer	1001461PA	ļ										
1, 2-dichlorot		34536		Benzei				34030	MI			NEO							
1, 3-dichlorof		34566			benzene			34301	<u> </u>	EX	TRA	CTA	BLI			n.c.'	D Tr		
1, 4-dichlorot		34571			chlorobe			34536	-		D'	Ш		*RI	E S G	KUU	1' 14		516
Dichlorodiflu		34668			chlorobe			34566 34571	-		B's thala	te Est	lers	Scree	en en		100	0069	
1, 1-dichloros		34496			chlorobe	zen		34371	-					l) phi		le			100
1, 2-dichlorou		34531 34501	-	Toluer	enzene			34010	\vdash					thala					292
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1, 2-dichloror		34704	_						П		<u>-</u>	yi ph				_		34	341
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Methylene Ch		34423																	
	achloroethane	34516																	
Tetrachloroet		34475																	
1, 1, 1-trichlo		34506																	
1, 1, 2-trichlo	proethane	34511							Ш										
Trichloroethy	/lene	39180						-											
REMARKS																			

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SAMPLE COLLE	CFED BY (Nai	ne, Grade, AFSC) E-7 , 9077	p	1	harles 21	2/	ordisort	7	724	-130	18
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			ALYSES REQUES	TED (check a	ppropriate blocks)						
	00.000000		Trichlorofluore		34488	МІ	SCELLANEOU	s			
VOLATILE HAL		S GROUP TI	Vinyl Chloride		39175		VOLATILES				
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Wolatile Halo	carbon Screen	32101					Xylene				81710
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Carbon Tetra		32102		PRES	GROUP TI	<u> </u>	Total organic	nalides		1002	100011
Chlorobenzer		34301	Trihalometha	ne Potential	1001465MT						
Chloroethane		34311	Total Trihalor	methanes	82080	-					
2-Chloroethy	lvinyl ether	34576				-					
(hlorotorm		32106	VOLATILE AR			-					
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1, 2-dichloro		34536 34566	Chlorobenzen	16	34301		EXTRACTAE				
1, 3-dichloro		34571	1.2-dichlorot		34536			PRE	S GRO	UP T4	
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1, 2-dichloro		34531	Ethylbenzene		34371	_	bis (2-ethylhe				39100 34292
1, 1-dichloro		34501	Toluene		34010	_	Butyl Benzyl		<u> </u>		39110
trans-l, 2-dic		34546				-	Di-n-butyl ph Diethyl phtha				34336
1, 2-dichloro	propane	34541				-	Dimethyl pht				34341
cis-1, 3-dichl		34704					Di-n-octyl ph			•	34596
	hloropropene	34699				\vdash					
Methylene C		34423			•						
	rachioroethane	34516 34475									
Tetrachloroe		34473									
1, 1, 1-trichl		34511									
1, 1, 2-trichl		39180									
REMARKS	7 10110			Н-	18						

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Use this space to		RAC		HG.	4///	<i></i> /					S	AMPLII IDENT	NG SITE	3 (7	5		ړ م	,			1	0	0
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VOLATILE HAL	OCARBONS ((VOH)		(10	160)		Trichlo			ethai	ne		34488	MI		LLA		OUS						
	PR	ES GR				-	Vinyl	`hlor	ide				39175		Ϋ́	T	Π	ΪT	PR	RES C	ROU	PTI		
	carbon Screen		100	1460	PH 101	-									Ху	lene	لسل						81	710
Bromodichlor Bromoform	romethane		-		104										Me	thyl	ethy	/i ket	one				81	595
Bromomethan	ne		113	TH	RIHALO	меті	HAN	ies (1	гим)		(10860)		Me	thyl	isob	utyl l	ket	one				596		
	chloride			3.2	102				1		RES	GROUI	P T I	_	For	tal o	LKAU	ne hal	lide	S		100	1210	6011
Chlorobenzer	ne			34.	301	_	Frihal	ometi	hane	Pote	ntial	10	01465MT											
Chloroethane				34.	311	_	Total	Friha	iome	thane	e s		82080	-	_									
2 Chloroethy	lvinyl ether				576	_			001	4 4 717	C.C. (1)	()))	(10850)		-		-							
Chlorotorm					106	-	VOLATI	LI. A	ROM			GROU			-									
Chlorometha	ne				418	Z	Volati						01461PA											
Dibromochio					105 / 536		Benze		omai	ne se	reen		34030	MI	SCI:	LLA	NE	ous						
1, 2-dichlorol					566		Chlore		ene				34301		ΕX	CTRA	ACT	ABL	I:S					
1, 3-dichlorol					571		1, 2-d			nzene			34536		I	Ι			p	R1:S	GRO	UP T4		
Dichlorodiflu				34	668		1, 3-d	chlor	ober	izene			34566			В'\								516
1, 1-dichloro				34	496		1, 4-d	chlor	ober	nzene			34571	Ш				sters	_			100		9PH
1, 2-dichloro	ethane			34	531		Ethyll	enze	ne				34371					lhexy			ate			100
1, 1-dichloro	ethene			34	501		Tolue	ne					34010	Щ				yl ph						292
trans-l, 2-dich	nioroethene			34	546									Щ				phtha		e				1110
1, 2-dichloro	propane	541									\vdash			<u> </u>	thalat						336			
cis-1, 3-dichle		704	_								\vdash				phtha phtha						596			
trans-1, 3-dic	hloropropene				699	-								-	וע	-11-00	.tyl	Pittig	.161					
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								LANCIUS SITE DE	4 n 4	Ï	We	11	B	11.	9	9	7		
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1/2 1/4 10	MDD1 141717	(24 hour clock)		08	30			GRAB] cc	МС	POSITE	<u> </u>			SUR	·s			
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SAMPLE COLLE	Wood War	+h E-7		407	70			Charles 71	2	10	odir	o X	7		72	24.	- 13	04	
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BASE SA	MPLE NUMBER	6 7	80	6	OD	7	1			_					<u> </u>				
		AN	IAL	SES RI	QUEST	ED /	chec	k appropriate blocksi	_							-			
VOLATILE HAL	OCARBONS (VO	H) (10860)	\dashv	Trichlo	rotluoro	meth	ane	34488	MI	_	ELLAN		S.						
	PRES	GROUP TI		Vinyl (Chioride			39175	\vdash	╀	OLA II	11.1.5	В	0 L'S	CP	OUP	TI		
Volatile Halo	carbon Screen	1001460PH							┝	١,	ylene		-	K1.5	(JIV	.,,,,	• • •	817	710
Bromodichlo	romethane	32101							┝	+-	lethyle	thyl k	eton	e e				815	595
Bromoform		32104		111417	A COURT A	NIL C	(3:111	d) (10860)	-	+-	lethylis							815	596
Bromometha	ne	34413	- 1 K	HALO	METHA	NE.3		S GROUP T1	+	+-	otal on				_		100:	106	oH
Carbon Tetra	chloride	32102	\dashv			- 0-		1 1001465MT											
Chlorobenzer		34301			rihalom			82080											
Chloroethane		34311	\dashv	(Otal	Tillalon				T	Τ									
2-Chloroethy	lvinyi ether	32106		/()[ATI	LE ARC	MA	HCS	(VOA) (10850)											
Chlorotorm		34418	寸	JEAN		,		ES GROUP T1											
Chlorometha		32105		Volati	e Arom	atic S		100146104											
Dibromochlo		34536		Benzer				34030	MI		LLLAS								
1, 3-dichlorol		34566		Chlore	benzene			34301		1	XTRA	CTAB							
1, 4-dichlorot		34571		1, 2-di	chiorobo	nzer	ie .	34536	_	L			F	PRES	S GF	ROU	P T4	201	<u> </u>
Dichlorodiflu	oromethane	34668			chlorobo			34566	<u> </u>	1	CB's	. 11					1000		516 PH
1, 1-dichloroe	ethane	34496		1, 4-di	chlorobe	nzer	16	34571	_	┸	hthalat					· ·	******		100
1, 2-dichloro	ethane	34531		Ethylb	enzene			34371	-		is (2-etl utyl Be								292
1, 1-dichloroe	ethene	34501		Toluer	ic			34010	-	-	ortyl Be Di-n-but								110
trans-1, 2-dich	loroethene	34546	_						-	-	iethyi								336
1, 2-dichloro		34541	\dashv						+-	-	imethy	<u> </u>		e e					341
cis-1, 3-dichle		34704	-						-	-	Di-n-oct								596
trans-1, 3-dic		34699	-							H		<u> </u>							
Methylene Ch		34423	+					<u> </u>	\vdash	\vdash									
	achioroethane	34516	\dashv						П										
Tetrachloroet		34475 34506	\dashv						\Box	Γ									
1, 1, 1-trichlo		34511	\dashv																
1, 1, 2-trichlo		39180	\dashv																
Trichloroethy	yiene	37100																	

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-		carbon Screen	32101	7					Xylene	:					81710
+	Bromodichlor	romethane	32104						Methy	iethyi k	ceton	e			81595
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	1, 2-dichloro		34536		Benzene		4030	М	SCELLA						
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	1, 4-dichloro	benzene	34571		1, 2-dichlorobenzene		4536	-	BCB.			I NES	GROC		39516
	Dichlorodiflu	oromethane	34668		1, 3-dichlorobenzene		4566 4571	\vdash	PCB's	ate Est	ters S	creen			069PH
	1, 1-dichloro	ethane	34496	_	1, 4-dichlorobenzene			+		ethylhe					39100
	1, 2-dichloro		34531		Ethylbenzene		4371	+		Benzyl					34292
	1, 1-dichloro		34501		Toluene		4010	+-		utyl pł					39110
	trans-1, 2-dicl		34546					+		yl phth					34336
	1, 2-dichloro		34541					+		hyl ph					34341
	cis-1, 3-dichl		34704	-				+		ctyl pł					34596
		hloropropene	34699					+							
	Methylene C		34423					+-							
		rachloroethane	34516	Н				+							
_	Tetrachloroe		34475	Н				-							
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_	1, 1, 2-trichl		34511					\top							
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	ENVI	RONMEN	ITA	L SA	MP	LIN	G DA	TA		OEHL U	SE ONLY	1 . 				
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	S20 JUZ 888	GROUP A	Т	Не	rdnes		161360	00900		Silica	00955	Τ	2, 4, 5-T		3'	9740
		00610	+	Iro		<u>. </u>		01045	\vdash	Specific Conduc	tance 00095	1	2, 4, 5-TP-Sil	vex	3	9760
Amm			+	Les				01051	\vdash	Sulfate	00945					
	nical Oxygen and			-				00927	\vdash	Surfactans-MBA	S 38260					
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011 &	Grease	00560		- Nic	kel			01067				+-				
Organ	nic Carbon	00680		Pot	assiu	m		00937			GROUP H	+-				
Ortho	ophosphate	00671		Sel	eniun	n		01147			39330	+				
Phos	horus. Tota	00665		Silv	'er			01077		Aldrin	19340	-				
				Soc	iium			06929	ļi	BHC Isomers		╁			-	
		GROUP D	\perp	Tha	alliu m	1		01059		a-BHC	39337	+-				
Cyan	ide, Total	00720	_ _	Zin	c			01092	-	b-BHC	39338 34259	+				
Cyan	ide, Free	00722	+	+-						d-BHC	39350	100			GRO	UP .
				-						Chlordane	39370	1	Sulfides			0745
		GROUP E			تك	لل		ROUP G	-	DDT Isomers	39370	+	Artimos			
Phen	ols	32730				Tota		70508	-	p, p-DDD	39310	+	-			
			_			ty, To		00410		p, p-DDE	39320	+				
		GROUP F					icarbona	te 00425		p, p-DDT	39380	+-	ON SI	TE ANA	LYSES	
Antir	nony	01097	\perp		mide			71870	-	Dieldrin	77969	+-	PARAMET			LUE
Arser	uic	01002		Car	bon !	Dioxi	ide	00405	 	Dursban		-	ow	50050	-	mg
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Comparison		EN	IVIRONMEN	TAL	L SAI	ИPI	LIN	G DATA	4			OEH	L US	E ONL	Y					
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Oil & Grease 00560 Nickel 01067 Organic Carbon 00680 Potassium 00937 Otthophosphate 00671 Selenium 01147 Aldrin 39330 Phosphorus, Total 00665 Silver 01077 Aldrin 39330 Sodium 09929 BHC Isomers 39340 Cyanide, Total 00720 Zinc 01092 b-BHC 39337 Cyanide, Free 00722 Jinc 01092 b-BHC 39338 Cyanide, Free 00722 Chlordane 39350 GROUP J Chlordane 39350 Sulfides 00745 Phenols 32730 Acidity, Total 70508 p, p-DDD 39310 Phenols 32730 Acidity, Total 70508 p, p-DDD 39320 Antimony 01097 Bromide 71870 Dieldrin 39380 ON SITE ANALYSES Arsenic 01002 Carbon Dioxide 00405 Dursban 77969 PARAMETER VALUE<				╀-	<u> </u>	_				├-	1410	iuity				-		· · · · · · · · · · · · · · · · · · ·		
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Antimony O1097 Bromide 71870 Dieldrin 39380 ON SITE ANALYSES		Room area plays by the	CROURE	+						-										
Antimony O1097 Brointe 1676 Dursban 77969 PARAMETER VALUE Arsenic 01002 Carbon Dioxide 00405 Dursban 77969 FARAMETER VALUE Barium 01007 Chloride 00940 Endrin 39390 Flow 50050 — mgd Beryllium 01012 Color 00080 Heptachlor 39410 Chlorine, Total 50060 Ø mg/1 Boron 01022 Fluoride 00951 Heptachlor Epoxide 39420 Dissolved Oxygen 00300 — mg/1 Cadmium 01027 Residue, Total 00500 Lindane 39782 pH 00400 7 units Calcium 00916 Residue, Filterable (TDS) 70300 Methoxychlor 39480 Temperature 00010 /, C °C Chromium, Total 01034 Residue, Nonfilterable 00530 Pramitol (Pramaton) XY4200000 Odor 00086 — Chromium VI 01032 Residue, Settleable 50085 <t< td=""><td></td><td></td><td></td><td>-</td><td></td><td></td><td></td><td></td><td></td><td>\vdash</td><td></td><td>-</td><td></td><td></td><td></td><td>٣</td><td>ON S</td><td>ITE ANA</td><td>LYSES</td><td></td></t<>				-						\vdash		-				٣	ON S	ITE ANA	LYSES	
Arsenic 01002 Caroni Dioxide 30400 Endrin 39390 Flow 50050 — mgd Barium 01007 Chloride 00940 Endrin 39390 Flow 50050 — mgd Beryllium 01012 Color 00080 Heptachlor 39410 Chlorine, Total 50060 ✓ mg/1 Boron 01022 Fluoride 00951 Heptachlor Epoxide 39420 Dissolved Oxygen 00300 — mg/l Cadmium 01027 Residue, Total 00500 Lindane 39782 pH 00400 ✓ units Calcium 00916 Residue, Filterable (TDS) 70300 Methoxychlor 39480 Temperature 00010 //.6 °C Chromium, Total 01034 Residue, Nonfilterable 00530 Pramitol (Pramaton) XY4200000 Odor 00086 — Chromium VI 01032 Residue, Settleable 50085 Toxaphene 39400 Iodide 71865 — Copper 01042 Residue, Vo				┼─	├					-					77969		PARAMET	ER	V	ALUE
Barium 01007 Chloride 00000 Heptachlor 39410 Chlorine, Total 50060	_			+-									-		39390	Flo)W	50050		mgd
Boron 01012 Fluoride 00951 Heptachlor Epoxide 39420 Dissolved Oxygen 00300 mg/l				+-									-			Ch	lorine, Total	50060	0	mg/1
Cadmium O1027 Residue, Total O0500 Lindane 39782 pH O0400 7 units				+	 					\vdash			poxi	de 3	9420			n 00300		mg/l
Cadmium 01027 Residue, Folia October Methoxychlor 39480 Temperature 00010 // 6 °C Calcium 00916 Residue, Filterable (TDS) 70300 Methoxychlor 39480 Temperature 00010 // 6 °C Chromium, Total 01034 Residue, Nonfilterable 00530 Pramitol (Pramaton) XY4200000 Odor 00086 — Chromium VI 01032 Residue, Settleable 50085 Toxaphene 39400 Iodide 71865 — Copper 01042 Residue, Volatile 00505 2, 4-D 39730 Sulfite 00740 —	<u> </u>			+-											39782	pН		00400		
Caronium	<u> </u>			+						\vdash)T	3	39480	Te	mperature	00010	1.	6 °C
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Copper 01042 Residue, Foliates	_			+-						H				3	9730	Sul	fite	00740	_	
			01042		1/6310	u C,	· 014			لــــا										

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	EI	NVIRONM	ENT	ΑL	. SAM	PLI	NG DA	TA		OEHL USE	ONLY							
(Use	this space for	mechanical im	print)							SAMPLING SITE IDENTIFIER (AFR 19-7)	034	5		96			10	4
										DASE WHERES	AMPLE COL	LEC	TED	- ,	/ -	- 1/		
										SAMPLING SITE	DESCRIPT	ION	<u></u>	11				
	i e									Undergr	,			Blo	19.	97		
DA	E COLLECT	ON BEGAN	TI	ME	COLLE	CTIC	ON BEG	AN		COLLECTION M	ETHOD							
8	E COLLECT	MDD)	9 (2	4 h	our clock	•)				GRAB	COMPO							
l ,	MAIL	ORIGINAL	0	13	3 4 5		181 7	TAC Clinic	/51	SPB, Hulman Roy	ional Airp	tno	. T. <u>=</u>	rre	<i>H</i> ~	te In	1 47	803
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	C W	oodwort			T.557		90.				F-FOLLOW			ANUE		121		6
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L	BASE SAM	IPLE NUMBER		10	> M	3 8		000	<u></u>	Check appropriate bio					<u></u>	لللل		
		CDOW		_	Hardne		ALTSE	00900	107	Silica	00955		2,	4, 5-T				39740
3.1		GROUI		-	Iron			01045		Specific Conductan	ce 00095		2,	4, 5-T	P-SIL	ex.		39760
H	Ammonia Chemical Ox		-	_	Lead			01051	-	Sulfate	00945	T						
<u> </u> -	Chemical Ox Demand			_	Magne	eium		00927		Surfactans-MBAS	38260	\vdash						
-	Kjeldahl Niti		20	-	Manga			01055	一	Turbidity	00076							
<u> </u>	Nitrate	006			Mercui	.		71900	-	,								
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_	Oil & Grease			\dashv	Potassi			00937	 									
\vdash	Organic Carb Orthophosph				Seleniu			01147	\vdash		GROUP H							
<u> </u>	Phosphorus,				Silver			01077	-	Aldrin	39330							
}	t nosphorus.	TOTAL SOC	-		Sodium	n		00929		BHC Isomers	39340	Π						
-		GROU	P D		Thalliu			01059	<u> </u>	а-ВНС	39337							
-	Cvanide, To		720		Zinc			01092	-	b-BHC	39338	1						
\vdash	Cyanide, Fre		722		_					d-BHC	34259							
\vdash	5, 5, 5, 5, 7, 10	-	-							Chlordane	39350		Π				GR	OUP J
-		GROU	PE		IT	Т	П	GROUP G	T	DDT Isomers	39370		Su	lfides				00745
1	Phenois		730	-	Acidity	y, To		70508	T	p, p-DDD	39310							
尸	. 11011013				Alkalir			00410		p, p-DDE	39320							
-		GROU	PF		Alkalir	nity,	Bicarbon	ate 1)0425		p, p-DDT	39300							
9500	Antimony	(A)	097		Bromio			71870		Dieldrin	39380			0	N SI	TE ANA	YSES	
\vdash	Arsenic		002		Carbon		xide	00405	T	Dursban	77969		P	ARAN	ETE	R	V	LUE
	Barium		007		Chloric			00940		Endrin	39390	Flo	ow			50050		mgd
 	Beryllium)12		Color			00080		Heptachlor	39410	1		e, Tot		50060	0	mg/l
	Boron	010)22		Fluorie	de		00951		Heptachlor Epoxide	39420	+		ed Oxy	gen	00300		mg/i
	Cadmium	010)27		Residu	e, To	otal	0 050 0		Lindane	39782	pH				00400	<u> </u>	units
	Calcium	009	16		Residu	e, Fil	iterable (TDS) 70300		Methoxychlor	39480	┼-		rature		00010	1.	6 °C
	Chromium,	Total 010)34		Residu	e, No	onfilterat	ie 00530		Pramitol) (Pramaton)	Y4200000	-	lor			00086		_
	Chromium V	7I 010)32	_	Residu	e, Se	ttleable	50 085		Toxaphene	39400	lo	dide			71865		
一	Copper)42		Residu	e, Vo	olatile	00505		2, 4-D	39730	Su	lfite			00740		-
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	E f	NVIRONME	NTAL	SAMP	LIN	G DATA		OEHL	USE ONLY				-			
(Use		mechanical imp						SAMPLING	:IER アノバイノ4	15		P		17.4	10	0
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DA.	TE COLLECT	ON BEGAN		COLLE		BEGAN		COLLECT	ION METHOD							
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			A-A	CCIDENT			CON	PLAINT	F-FOLLO	WUP/	CLE	ANUF				
	ASON FOR BMISSION	EP		OUTINE/			NPE	KS.	O-OTHER	(spec	(fy)	_		T	T	
	BASE SAM	PLE NUMBER	/.	P	8	000	5		OEHL PID							
				/	LYSES REQUESTE		Check appropri	ate blocks)								
(de)	and Specific	GROUP	A X	00900		Silica	00955		2,	4, 5-1	r			39740		
	Ammonia	0061	。文	Iron	01045		Specific Cond	luctance 00095		2,	4, 5-1	P-SIL	/ex		39760	
	Chemical Oxy Demand	ygen 0034	o X	Lead		01051		Suifate	00945							
	Kjeldahl Nitr		5	Magnesi	um	00927		Surfactans-M	BAS 38260	<u> </u>						
	Nitrate	0062	0 X	Mangan	ese	01055		Turbidity	00076	_				· .		
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	Oil & Grease	0056	0 🗙	Nickel		01067				_ _	_					
	Organic Carb	on 0068	0	Potassiu	m	00937										
	Orthophosph	2046	1 ×	Selenius	n	01147			GROUP H							
	Phosphorus,	Total 0066	5 🔀	Silver		01077		Aldrin	39330	$oldsymbol{ol}}}}}}}}}}}}}}}}}$						
				Sodium		00929		BHC Isomers	39340		<u> </u>					
		GROUP	D	Thalliur	n	01059		a-BHC	39 33 7							
	Cvanide, Tota	al 0072	• X	Zinc		01092		b-BHC	39338							
	Cyanide, Free	0072	2					d-BHC	34259				1 .	71		0110
								Chlordane	39350		Ш			<u></u>		OUP J
		GROUP	E		TT	GROUP G		DDT Isomers	39370		Su	itides			(00745
	Phenois	3273	0	Acidity,	Total	70508		p, p-DDD	39310							
				Alkalini	ty, To	al 00410		p, p-DDE	39320						•	
		GROUP	F	Alkalini	ty, Bic	arbonate 00425		p, p-DDT	39300							
	Antimony 01097 Bromide 7187							Dieldrin	39380	_				EANA		
X	Arsenic 01002 Carbon Dioxide 00403							Dursban	77969			ARAN	METE		VA	LUE
Ź	Barium 01007 Chloride 00940							Endrin	39390	_				50050		mgd
	Beryllium 01012 Color 00080							Heptachlor	39410	_i		e, To		50060	0	mg/ i
	Boron	0102	2	Fluoride	:	00951		Heptachlor E				ed Ox	ygen	00300		mg/i
X	Cadmium	0102	7	Residue				Lindane	39782	pH		-4		00400	7	units
	Calcium	0 091	6			able <i>(TDS)</i> 70300		Methoxychion			<u> </u>	ature		00010	1.6	
X	Chromium, T	ot al 0103	4	Residue	Nonfi	iterable 00530		Pramitol (Pramaton)	XY4200000	Od				00086		
	Chromium VI 01032 Residue, Settleable 50085							Toxaphene	39400	-	lide			71865		
	Copper	0104	2	Residue	Volat	ile 00505	ı	2, 4-D	39730	Su	fite			00740		

	EN	VIRC	NMENT	AL	SAMPLING [DATA		OEHL USI	ONLY			
(Use	this space for m							SAMPLING SIT IDENTIFIER (AFR 19-7)	034	5	PG	100
								BASE WHERE	SAMPLE COLL		, , , , , , , , , , , , , , , , , , ,	
		N.						SAMPLING SI	2 //w/ma	n O N	Field IN	
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	·		AN 17	TIME	COLLECTION BE	GAN		COLLECTION	METHOD	101		
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	Ch	1000		<u>L_</u>		90770		Karle	F-FOLLOW	IP/C	LEANUP	
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306	MISSION L	لحنات		Τ,				* 30 = 1 2	SEHL PIO		三种性質的	
	BASE SAMP	LE NU	MBER	6		000				3 A		
				T 1		SES REQUESTE	D (Check appropriate t Silica	00955		2, 4, 5-T	39740
22			GROUP A	\sqcup	Hardness			Specific Conducts			2, 4, 5-TP-Silvex	39760
	Ammonia		00610	\sqcup	Iron	01045		-Sulfate	00945			
	Chemical Oxy Demand		00340	\vdash	Lead	01031	X	Surfactans-MBAS	38260			
	Kjeldahl Nitro	gen	00625		Magnesium	01055		Turbidity	00076			
	Nitrate		00620		Manganese	71900	X	raibidity				
	Nitrite		00615		Mercury	01067						
	Oil & Grease		00560	\vdash	Nickel	00937	-					
L_	Organic Carbo		00680	\vdash	Potassium	01147	- 4		GROUP H			
_	Orthophospha		00671	\vdash	Selenium Silver	01077	5.62	Aldrin	39330			
	Phosphorus, T	Cotal	00665	+	Sodium	06929		BHC Isomers	39340			
200			GROUP D		Thallium	01059	_	a-BHC	39337			
 	C with Take		00720	++	Zinc	01092		b-BHC	39338			
<u> </u>	Cyanide, Tota Cyanide, Free		00722	+				d-BHC	34259			
├	Cyanade, 1 tee					<u> </u>		Chlordane	39 35 0			GROUP J
			GROUP E			GROUP G		DDT Isomers	39370		Sulfides	00745
al fair	Phenois	<u></u>	32730		Acidity, Total	70508		p, p-DDD	39310			
-	Titenois			† †	Alkalinity, Total	00410		p, p-DDE	39320	_		
			GROUP F		Alkalinity, Bicar	bonate 00425		p, p-DDT	39300	L		
F	Antimony	33	01097	\Box	Bromide	71870		Dieldrin	39380		ON SITE ANA	***************************************
┝	Arsenic		01002		Carbon Dioxide	00405		Dursban	17969	L	PARAMETER	VALUE
H	Barium		01007	V	Chloride	0 094 0		Endrin	3 939 0	Flo		mgd
-	Beryllium		01012	X	Color	00080		Heptachlor	39410		lorine, Total 50060	O mg/1
十	Boron		01022	X	Fluoride	00951		Heptachlor Epox		—	ssolved Oxygen 00300 00400	mg/l
	Cadmium		01027		Residue, Total	0 05 00	_	Lindane	39782	pH		, °C
	Calcium		00916		Residue, Filteral		_	Methoxychlor	39480	├-	00000	1.6
一	Chromium, T	otal	01034		Residue, Nonfilt	erable 00530	_	Pramitol (Prameton)	XY4200000	⊢ −		
\vdash	Chromium VI	I	01032		Residue, Settlea		L	Toxaphene	39400	₩		=
	Copper		01042		Residue, Volatil	e 00505		2, 4-D	39730	Su	lfite 00740	
1	MARKS						u . o					

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	BASE SAM	PLE!	NUMBER	P		86		000	7		IC MO			200	7	T 5	
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			GROUP A		Haro				00900	_	Silica Specific Conductance		₽	2, 4, 5-TP-Sih	ex		39760
	Ammonia		00610	lacksquare	Iron				01045	Ŀ	Sulfate	00945	十	-, ,, -			
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	Orthophosph		00671	+-	Sele				01077	-20	Aldrin	39330	\vdash				
	Phosphorus,	Total	00665	-	Sodi				06929	-	BHC Isomers	39340	T				·
#300000E	550 Bill 557 677	.364	GROUP D	+		lium			01059	-	a-BHC	39337	+-				
*		<u> </u>	00720	+-	Zinc				01092	-	ь-внс	39338	1				
_	Cyanide, Tot Cyanide, Fre		00720	-	2,110					\vdash	d-BHC	34259	\mathbf{I}^{-}				
	Cyanuce, Fie		00120					-		X	Chlordane	39350				GR	OUP J
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i dia	Phenois	_لنس	32730	+	Acid	ity.	Total		70508		p, p-DDD	39310					
	r HellO12		32.50	+			y, Tot	al	00410		p, p-DDE	39320					
			GROUP F	\top	Alka	linit	y, Bica	rbonate	00425		p, p-DDT	39300					
1000	Antimony	01097	+	Bror				71870	Z	Dieldrin	39380			E ANA			
_	Arsenic		Carb	on E	obixoid	;	00405		Dursban	77969		PARAMETE		VA	LUE		
-	Barium	\top	Chlo	ride			00940	X	Endrin	39390	Flo		50050		mgd		
	Beryllium		Colo	ſ			00080		Heptachlor	39410		lorine, Total	50060	0	mg/1		
	Boron		Fluo	ride			00951		Heptachlor Epoxide	39420	+	solved Oxygen			mg/l		
	Cadmium		01027				Total		00500	X	Lindane	39782	pH		00400	7	units °C
	Calcium						s) 70300	K	Methoxychior	39480	∔- —	mperature	00010 00086	1.6			
П	Chromium, T						00530	Ļ	(Pramaton)	4200000	Od		71865				
	Chromium V				Settle		50085	X	Toxaphene	39400	┼	lide					
\Box	Copper		01042		Resi	due,	Volati	le	00505	K.	2, 4-D	39730	Sul	ifite	00740		
	MARKS																ā

2. LABORATORY DE	FOR	HING A	HALYSIS		3. LAB SAMP	L E	NUM	DER		A. RE	QUESTO	DR SAMP	LE NUMBER
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7. SITE DESCRIPTIO		E COL	LECTION	IN FO					5	Eb. 86		19 F	ها ته . د
1, 2, 2, 2, 2, 2, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,	-									ON-SITE	NAL Y	TICAL F	18. DISS 02
S. SITE LOCATION N	10	9. FLC		SITE ODSS AL/MI				00041		000 10 °C		00400 UNITS	00 30C
11. COLLECTION DA	TE/PI	RIOD			12 NAME	o F	COL	LECTOR	IS. RES	LTS OF OT	HER OF	N-BITE A	NAL Y BES
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18. SAMPLING TECH	TE	_	11 34 AT	1 60	14. PHONE	ENL	JM B E						-
IB. REASON FOR SAI	MPLE	UBMIS	HON										
				ANAL	YSES REQUE	EST	ED	AND RES	ULTS				
			A. PRI	MARY	DRINKING WA	TEF	ST/	NDARDS	(40CFR	141)			
	PRESE	RVATIO	ON GROUP F			\Box			PR	ESERVATIO		JPC (
PARAMETER		TOTAL	Д 6/1		MAX LEV ALL			PARAM		TOTAL	 		MAX LEV ALLWO
ARSENIC		01002			50 Д G/L		NIT!	RATE AS	hod)	V /		0.18	10 MG/L
				-	1000 Д G/L	\neg			PF	TOTAL		ROUP G	MAX LEV ALLWO
BARIUM		01007		•		\dashv	FI	PARAM	E168	00951			See toble in AFR 161-44
CADMIUM		01027		•	10. µ G/L			RBIDITY		00076		Units	1 Unit
СНЯОМИИ		01034		•	50 Д G/L	-	 				1	a a saabasa	
LEAD		01051		•	50 Д G/L 2 Д G/L	_	6	4.4	-0'07	44	_	(,02	
MERCURY	RCURY 71900					_	ي	MC)	na	we_	 	.,	
SELENTUM		01147			10 Д G/L					+	-		
SILVEP		01077	<u> </u>		SO J G/L		<u></u>						
				1	B. OTHER	-0.1			SERVATI	ON GROUP	G		
PRESERV	TOTAL		μG/L	PA	RAMETER	TO	TAL	MG		PARAME	TER	TOTAL	MG/L
PARAMETER		-		Keid	ity, Mineral	00	436			Sulfate As 504		00945	•_
COPPER	0104	-			uty, Total, As	00	435			Surfactant As LAS	MBAS	38260	•
IRON	0104	+		Alka	lin, Phenoith	00	415						
MANGANESE	01055			Alkal	inity, Total, As	00	410						
ZINC	01092	+	• •	CNO		00	940						
CALCIUM As Ca	00916		ng 1	Hard	ness As		900						
MAGNESIUM as Mg	00927		ES E	Resi	Oş idue,	_						VATION	GROUP J
POTASSIUM	00937		_	Filu	able (TDS)	_	515			PARAM	TER	1	
SODIUM	00929		<u> </u>	Resi Non-	Filtrable (SS)	00	530						
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1. ORGANIZATION	REQU	ESTING	ANALYSIS							CHEMIST			
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			SAMPL	E COL	LECTION	MFOR	MATION			LAB	RECEIVED	COM	PLETED	
	7. MTE 0	ESCRIPT				1	,			3 1	-ch. 36		فاع. و 4	
		•					10. WEAT	W.F.B.	00041	19. WAT	ON-SITE A	NALYTICAL	18. DISS 0,	
	S. SITE U	OCATION	HO	9. FLC		81 T E 00088 AL/MIN	1	пъп	*****		000 10	0040 UNIT	0 0	0c ≱0€ 46' L .
				2.05		1		OF	COLLECTOR	19. RES		HER ON-BITE		
	11. COLL	ECTION D	A16/P6							1				
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	IS. REAS	N FOR B	AMPLE S	UBMISS	ION									,
							VEST DEOU	EST	ED AND RES	SULTS				
			<u> </u>			MARY	DEINKING W	ATER	STANDARDS	(#CFR	141)			
							JAMAN III			PF	ESERVATIO	N GROUP C		
		AMETER		POTAL	N GROUP		MAR LEV AL		PARAM		TOTAL	ME/L	MAX LEV AL	L WE
-			┝╼┼				\$0 ∐ G/L		NITRATE AS	N (Codmi	00620		10 MGV	L .
	ARSENI			01002		•			Reduction Met	PI	RESERVATI	ON GROUP G	(045)	
_	BARIUM			01007			1000 H G/L		PARAM	ETER	TOTAL	MG/L	See male to	LWD
	CADMIU	1.1		01027			10. H G/L	ł	FLUORIDE		00951		See mble in AFR 161-44	
			!				50 H G/L		TURBIDITY		00076	Units	1 Unit	
	CHRONI	in .	} -}	01034		•		_				:		\top
	LEAD			01051		•	50 Д G/L			11	11/11			+]
	MERCUR	Į.		71900			2 H G/L	_4	Girs)	Cyan	il total	۷.٥١		
	SELENT			01147			ю д сл	1						
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	SILVER			01077	<u></u>		B. OTHER		ALYSES					
. ———	1	PRESER	VATION	GROUP	F				PRE	SERVATI	ON GROUP G		- WE/L	
		ETEN	TOTAL		IG/L		AMETER	101	AL MG	<u></u>	Sullate As			
	COPPER	i	01042			Acidit As Co	y, Mineral CO ₂	004	136		804	00945		•
		<u>: </u>	01045	 		CoCO.	y, Total, As	004	135	•	Surfactants As LAS	38260		•
	IRON		01043				n, Phenoith	004						1
	MANGA	ESE	01055	 		Alkalii	CO 2	-						
	EINC	İ	01092			C.CO		004	110					
	CALCIU	M As Ca	00916		<u>=1</u>	Cylon	de	009	140					'
	}	+	 	 	<u> </u>		* 50 As	005	200] :			
	MAGNE	DUM as Me	00927	+		Resid		009			PARAME	RESERVATION	GROUP	
	POTASS	TUM	00937	厂		Filtre	He (7'DS)	├─			FARAME			
	SODIUM		00929			Non-F	iltrable (SS)	001	30					_ <u></u>
		(6, 3				20010	4	009	100		<u>:</u>			
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	L	:	<u>; </u>							2024	NI P WATE	P ANALYSIS		15042

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	2. LABO	RATORY	ERFOR	ING A	ALYSIS		3. LAB SAM	PLE	NUMBER		4. RE	QUEST	OR SAMP	LE NUMBER
İ		1) EH				0	•	876		10	08	600	04
		<u> </u>				:			2/9	B. DATE	RECEIVED		& DATE	ANAL YBIS
				E COL	LECTION	INFO	RMATION			5*	r(5, 86		19 E	67 8 W
.	7. MTE	DESCRIPT	ON		_		•				ON-SITE	ANALY		RESULTS
		OCATION	NO	9. FLC	WRATE AT	BITE	10. WEAT	HER	00041	10. WAT	000 10	17. PH	00400	18. DISS 0,
- 1						AL/M					°c		UNITS	MG/L
	11. COL	ECTION P	ATE/PE	RIDO			12 NAME	LOF	COLLECTOR	19. 825	ULTS OF O	I A E A O	** BITE A	NALTEL
						* C.	14. PHON	EN	M& ER	1				
	15. SAMP	LING TE	HNI OHE	в 5	11 34 Ai	1 00				1				
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						ANAL	YSES REQL	EST	ED AND RES	SULTS		 		
					A. PRI	MARY	DRINKING W	ATEI	STANDARDS		ESERVATIO	N GBOL	PC:	
					M GROUP !		MAX LEV AL	L wo	PARAM		TOTAL			MAX LEV ALLWD
, _ · · ·		RAMETER		TOTAL	A 0/1	_			NITRATE AS	N (Codesis	00620			10 MG/L
	ARSENT	F		01002		•	10 H C√r		Reduction Met	hod)	RESERVAT	ION GR	OUP G	<u> </u>
_	BARIUM			01007		•	1990 以G/L		PARAM		TOTAL			DAR LEV ALL NO
	CADMIU	1 · · · · · · · · · · · · · · · · · · ·		01027			10. H G/L		FLUORIDE		00951			Soo mblo in APR 161-44
+						i	50 H G/L		TURBIDITY		00076		Unite	1 Unii
 	CHROM	LM .		01034		•							•	
	LEAD			01051		•	ж Д СЛ			0//	0	1		
•	MERCU	RY		71900			2 Д G/L		GROE)	Chen	up.	1	0 116	(L
-	BELENT	tru .		61147		•	10 Д С/L)			L		
	BILVER			01077			50 从 G/L							
- 			:		25 - 7 - 7 - 7 - 7 - 7 - 7 - 7 - 7 - 7 -		B. OTHE	RAN						
		PRESER		GROUP	F			T TO			PARAME		TOTAL	ME/L
	PARA	PETER	TOTAL		IE\r		ty, Mineral	+			Sullate Ae		00945	
	COPPE	2	01042	ļ		A C	CO, Ity, Total, As	00	436		504 Surfectents	MBAS		
	IRON		01045			CoCC		00	435		A. LAS		38260	<u> </u>
	MANGA	NESE	01055			1 '	in, Phenoith aCO	00	415					
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	21110	-	-	 	es.			1	940					
	CALCI	UM As Ca	00916	-	<u> </u>	Chlo	ness As	-	-		<u>:</u>			
	MAGNE	BIUM as M	00927	<u> </u>	10 E	CaC) ,	00	900			RESERV	ATION	ROUP
	POTAS	STUM	00937	 	_ <u>me</u>	Resi Filtr	due, able (TDS)	00	515		PARAME			
	BODIU		00929		<u> me</u>	Resi	due, Filtrable (SS)	00	5 30					
	1	10		+		Reel		00	500					
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		N REOUI	STING	ANAL YSIS	Conc	uctance				CHEMIST				
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	2. LABORATORY PE	RFOR	ING A	HALYSIS		3. LAB SAM	PLEI	NUMBER		A. PE	DUESTOR	SAMP	LE NUMBE	A
	0	EH	12			075	(1	18		G	P86	00	06	00029
				LECTION	INFO	RMATION			LAD	RECEIVED	• •	COMP	LETED	•
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						D. WEAT	HER	00041	IS. WAT	ON-SITE A		AL R	18. DISS	0,
	S. SITE LOCATION N	10	9. FLC		81 T E 000 89 AL/MI	N .				000 10 PC		00400 JNI 7 5	<u> </u>	00300 MG/L
	11. COLLECTION DA	TEPE	RIOD			12 NAME	OF (COLLECTO	15. 725	7C 1 8 0 7 0 1	NER UN-B		446 436	
	18. SAMPLING TECH	HI OHE	в 5	11 34 A	1 '€5	14. PHON	E NU	MBER						
·	IS REASON FOR SA	MPLE 1	IU BMI SI	HON										
					ANAL	YSES REQU	EST	ED AND RE	SULTS				-	
				A. PR	MARY	DRINKING W	ATER	STANDARD	S (MCFR	141)				
		PRESE	RVATIO	ON GROUP	F				METER	TOTAL	ME/L		MAX LEV	ALLWD
	PARAMETER		POTAL	Д 6/		MAX LEV AL		NITRATE AS					-	
	ARSENIC	- 1	01002		•	50 ∐ G/L		Reduction Me	thod)	00620	ON CROI	ا و	10 MG	
-	BARIUM		01007			1000 Д G/L	-	PARA	METER	TOTAL	MG/		MAXLET	
	CADMIUM		01027			10. µ G/L		FLUORIDE	+	00951	0	۵.	500 mblo : AFR 161-4	
	CHROMIUM		01034			50 H G/L		TURBIDITY	· 	00076	2 (Units	1 Unii	
,	LEAD		01051		•	90 Д G Л	_							
•	MERCURY	21000				2ДGЛ							·	
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	SILVER		01077	<u> </u>		50 JL G/L					<u> </u>			
					1	B. OTHER	AN		ESERVATI	ON GROUP O			(414	
	PRESERV	ATION TOTAL		HG/L	FA	RAMETER	TOT		3/L	PARAME		TAL	₩6/	L
	COPPER	01042	1		At C	ty, Mineral	004	136		Sullate As SO4		7945	7	•
	IRON	01045	T			ity, Total, As	004	35		Surfactante As LAS	MBAS 3	260		•
	MANGANESE	01055			A. C	in, Phenolth	004	115		Cala			_ 45	
	EINC	01092			CoCC	inity, Total, As 3	004	110						
	CALCIUM As Ca	00916		<u>m</u> g 1	Chlo	ness As	009	••0	4-					
	MAGNESIUM as Me	00927	<u> </u>	<u>e 1</u>	CaC	٠,	009	900		P	RESERVAT	TION G	ROUP	
	POTASSIUM	00937		<u> </u>		oble (TDS)	005			PARAME	TER	_		
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7. SITE DESCRIPTIO	' N	· #			1.7					CN-SITE A	NALYT	ICAL R	ESULTS
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11. COLLECTION D	ATE/P	ERIOD							ļ				
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IS. REASON FOR SA	MPCE	300											
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						DH-MP.HA-	T		PR	SERVATIO	N GROU	PC	
	PRESE	RVATIO		A G/I		MAX LEV ALL	Lwa	PARAM	ETER	TOTAL	м	6/L	MAX LEV ALLWO
PARAMETER		TOTAL		4 67.				NITRATE AS	N (Cadmiu	00620			Ja Nga
ARSENIC		01002				50 J G/L		Reduction Me	thod)	ESERVAT	ON GE	OUP G	(23-)
		01007				1000 H G/L	1	PARAM		TOTAL		a/L	MAX LEV ALLWO
BARIUM					•		_		<u> </u>	00951			See table to AFR 161-44
CADMIUM		01027			•	10. H G/L		FLUORIDE			 		
CHROMUM		01034				50 Д G/L		TURBIDITY		00076		Units	1 Unit
CHRONOM					•	50 H G/L		(10 B)					
LEAD .		01051			•	30 A G/E		CARB)			10	>	
MERCURY		71900	-			2 Д G/L	Ī	OIL-GA	EASE		<0	,3	ļ
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SELENTUM		01127				10 Д СЛ	\dashv						
SILVER		01077	ł			50 从 G/L					<u> </u>		l
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PRESERV	ATION	GROUP	F							PARAME		TOTAL	MG/L
PARAMETER	TOTA		UG/L		PA	RAMETER	TOT	TAL MG	·/L	Sulfate As			
	0104	,				ty, Mineral aCO ₂	00	436	•	504		00945	•
COPPER	0104	- 				ity, Total, A .	00	435		Surfactanti As LAS	MBAS	38260	
IRON	0104	3			Cacc		00.	-33		ATEM			
MANGANESE	01055			_		ia, Phenoiti aCO 3	004	4.2				ļ	
					Alkal	inity, Total. As	i	•)					
ZINC	01092	<u> </u>		•	CeCC		-						
CALCIUM As Ca	00916	.		<u>m e</u> -	Сијо	ride	009	940				 	
				mg	Hard	ness As	004	900	_			<u> </u>	
MAGNESIUM ME	00927			<u> </u>	Resi		-					VATION	GROUP J
POTASSIUM	009 37	i		<u>mg</u>		able (TDS)	00	515		PARAMI	TER	 	
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1. GRGANIZATION		-			Spec	uctanes	00	095	<u> µahoe</u>	CHEMIST		<u> </u>	BQ.
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SOTABLE WATER ANALYSIS

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	CROURA		Hardnes		00900		Silica	00955	Τ	2, 4, 5-T			39740
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	GROUP D		Thallium	1	0 1059		a-BHC	39337					
Cyanide, Tot	al 00720		Zinc		01092		b-BHC	39338	1				
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Antimony	01097	-	Bromide		71 87 0 00405	\vdash	Dursban	77969	+-	PARAME			LUE
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Barium	01007	+-	Chloride		00940	\vdash	Heptachlor	39410	₩-	lorine, Total	50060		mg/l
Beryllium	01012	+-	Fluoride		00951	\vdash	Heptachlor Epo		Dis	solved Oxyg	en 00300		mg/l
Boron Cadmium	01022	+-	Residue,		00500		Lindane	39782	pН		00400	7.4	units
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